National Energy Board | Office national de l'énergie

CNSOPB — CANADA-NOVA SCOTIA OFFSHORE PETROLEUM BOARD

CANADA-NEWFOUNDLAND and LABRADOR OFFSHORE PETROLEUM BOARD

OFFSHORE PHYSICAL ENVIRONMENTAL GUIDELINES

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ABBREVIATIONS AND DEFINITIONS

The terms and abbreviations listed in Table i-1 are used in this document.

Table i -1 – Terms and Abbreviations

Term/ Abbreviation	Description
Aviation Weather Observer	Qualified individual tasked with aviation weather observing duties who • has a detailed practical knowledge of and experience in all observing standards and techniques related to aviation weather observing; • is conversant with relevant WMO standards and guidelines; and • understands the data requirements for forecasting and climatological purposes. Aviation weather observer qualification is a responsibility of the Operator.
Aviation Weather Observing	Aviation weather observing procedure
Aviation Weather Reporting	Aviation weather reporting procedure
CAPP	Canadian Association of Petroleum Producers
CAR	Canadian Aviation Regulation
CCG	Canadian Coast Guard
CIS	Canadian Ice Service
C-NLOPB	Canada-Newfoundland and Labrador Offshore Petroleum Board
CNSOPB	Canada Nova Scotia Offshore Petroleum Board
CTD	Conductivity - Temperature - Depth. Profile data used to determine seawater properties, e.g. density, temperature, salinity.
Drilling Regulations	Canada Oil and Gas Drilling Regulations Newfoundland Offshore Petroleum Drilling Regulations Nova Scotia Offshore Petroleum Drilling Regulations
GFA	A graphical aviation forecast in chart format covering Canadian Domestic Airspace issued by MSC for Nav Canada.
ICAO	International Civil Aviation Organization
Ice Forecasting Contractor	Contractor responsible for Installation sea ice and iceberg forecasting.
Ice Management Contractor	Contractor responsible for Installation ice management and observing program.
Ice Management Plan	A description prepared by the Operator that describes the offshore Ice Management Program. Submitted by the Operator to the Regulator.
Ice Management Program	Ice management activities for an Installation.
ICE	The Shipboard Ice Code. A formatted ice observation defined in MANMAR. A format for marine weather, sea state and ice reports.
ICEBERG	The Iceberg Message. A formatted iceberg observation defined in MANICE. This code was developed by MSC and IIP and supplements

Term/ Abbreviation	Description
	the WMO ice code.
Ice Observer	Qualified individual tasked with ice observing and management duties in accordance with the Ice Management Plan, who has received training in: • ice monitoring and tracking techniques; • ice deflection techniques; • ice characterization and reporting (including ice codes); • the use of radar for ice detection; and • radio communication. Ice observer qualification is a responsibility of the Operator.
Ice Observing	Ice observing procedure
Ice Reporting	Ice reporting procedure
IIP	U.S. Coast Guard International Ice Patrol
Industry	The offshore petroleum industry.
Installation	The offshore exploration or production installation (e.g. semisubmersible, drillship, fixed production platform, FPSO vessel) or a group of these installations.
Installation Regulations	Canada Oil and Gas Installation Regulations Newfoundland Offshore Petroleum Installation Regulations Nova Scotia Offshore Petroleum Installation Regulations
MANAIR	Manual of Standards and Procedures for Aviation Weather Forecasts
MANICE	Manual of Ice Observing. Also referred to in the context of an ice observing standard.
MANMAR	Manual of Marine Observations. A Canadian guide to the general marine observations and reporting using WMO Code FM13.
MANOBS	Manual of Surface Weather Observations. Also referred to in the context of an (land-based) aviation observing standard.
Marine Weather Observer	Qualified individual who is tasked with marine weather and sea state observing duties and who: • has a detailed practical knowledge of and experience in all observing standards and techniques related to marine weather observing; • is conversant with relevant WMO standards and guidelines; and • understands the data requirements for forecasting and climatological purposes. Marine weather observer qualification is a responsibility of the Operator.
Marine Weather and Sea State Observing	Marine weather and sea state observing procedure.
Marine Weather and Sea State Reporting	Marine weather and sea state reporting procedure.
MEDS	Marine Environmental Data Service
Metadata	Metadata or "data about data" describe the content, quality, condition, and other characteristics of data.

Term/ Abbreviation	Description
METAR	A character-based format for an hourly aviation weather observation. Also referred to as the aviation weather report.
Meteorologist	A qualified individual responsible for weather forecasting. Meteorologist minimum qualifications are described in these *PEGs*.
Meteorology Program	Meteorological monitoring activities for an Installation.
Monitoring Program	Weather, sea state and ice measurement, observation and reporting programs for an Installation, including all management of these programs.
Monitoring Program Management	Procedure for management of a Monitoring Program.
MSC	Meteorological Service of Canada
NAVCAN	NAV CANADA, the Canadian provider of civil air navigation services.
NEB	National Energy Board
NWS	National Weather Service (of the United States)
Oceanographic Contractor	Contractor responsible for providing, installing and maintaining oceanographic equipment.
Oceanographic Observing	Oceanographic observing procedure
Oceanographic Program	Ocean monitoring activities for an Installation
Oceanographic Reporting	Oceanographic reporting procedure
Oceanographer	A qualified oceanographer is a graduate of a specified program in oceanographic studies at a recognized university.
Operator	The Operator of the offshore installation.
PEGs	Offshore **P**hysical **E**nvironmental **G**uideline**s** (this document).
PMO	MSC Port Meteorological Officer.
Policies & Procedures	Observing and Reporting policies and procedures developed for the Offshore.
Program Description	An outline prepared by the Operator that describes the offshore monitoring program. Submitted by the Operator to the Regulator.
Production and Conservation Regulations	Canada Oil and Gas Production and Conservation Regulations Newfoundland Offshore Area Petroleum Production and Conservation Regulations Nova Scotia Offshore Area Petroleum Production and Conservation Regulations
Regulations	Legislation applicable to environmental programs for the Offshore Petroleum industry (listed in Section 1 of these PEGs).
Regulator	C-NLOPB, CNSOPB, and/or NEB as appropriate
SAWRS	Supplementary Aviation Weather Observations (an obsolete aviation observing standard formerly used in the Offshore)
Synoptic Ship	A report based on WMO Code FM13 and also described in MANMAR. These reports were formerly referred to as MANMAR reports but the term MANMAR has become obsolete, except where references to the manual are noted.
SPECI	A character-based format for a special aviation weather observation.

Term/ Abbreviation	**Description**
TAF	An Aerodrome Forecast that is intended to be used wholly or partially for the arrival, departure, and movement or servicing of aircraft.
TC	Transport Canada
WAVEOB	A formatted spectral wave data report.
Weather Forecasting Contractor	Contractor responsible for weather and sea state forecasting program on an Installation.
Weather Observer Instructor	Qualified individual with considerable practical experience in aviation and marine observing, references to that competence plus experience and training in instructional techniques.
Weather Observing Contractor	Contractor responsible for weather and sea state observing program on an Installation.
WMO	World Meteorological Organization
WMO Code FM13	International report format of surface weather observation from a sea station. [16]

1.0 INTRODUCTION

These *PEGs* are intended to clarify requirements for the Operators of petroleum drilling or production installations (the Installation) concerning the observing, forecasting and reporting of physical environmental data which appear in the following federal, Nova Scotia, and Newfoundland and Labrador Regulations (the *Regulations*):

- *Canada Oil and Gas Installation Regulations*
- *Canada Oil and Gas Drilling Regulations*
- *Canada Oil and Gas Production and Conservation Regulations*
- *Newfoundland Offshore Petroleum Installation Regulations*
- *Newfoundland Offshore Petroleum Drilling Regulations*
- *Newfoundland Offshore Area Petroleum Production and Conservation Regulations*
- *Nova Scotia Offshore Petroleum Installation Regulations*
- *Nova Scotia Offshore Petroleum Drilling Regulations*
- *Nova Scotia Offshore Area Petroleum Production and Conservation Regulations*
- *Transport Canada Air Regulations and Aeronautics Act*

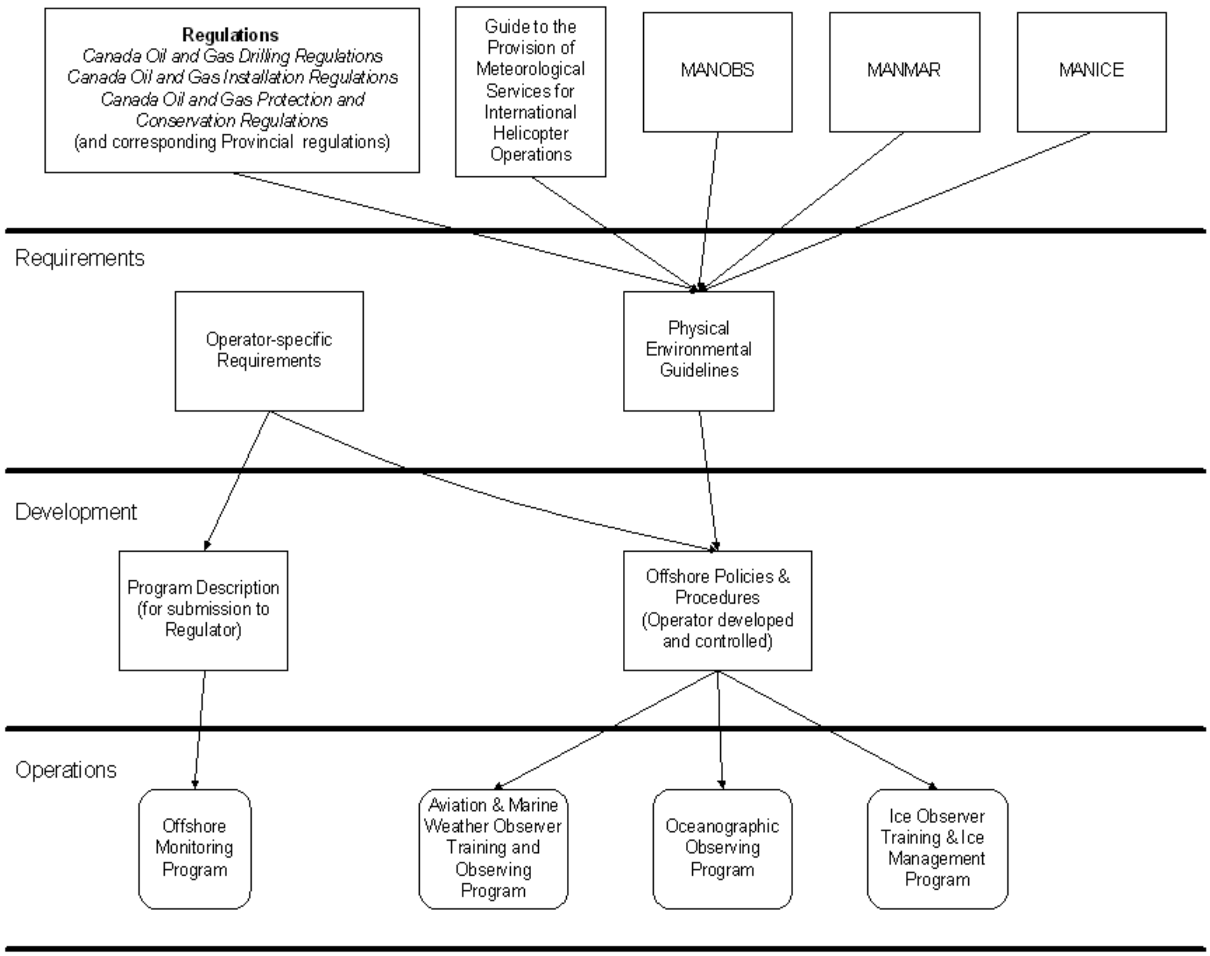
The primary objective of the *PEGs* is to provide to the Operator, a set of clear and precise program and best practice procedures which, when followed, will fulfill the regulatory requirements pertaining to the Physical Environment. Information collected during the program is also necessary to establish a sound and reliable data base, which in turn will assist Operators in carrying out Environmental Effects Monitoring programs and in planning future operations in the area, and the Regulators in performing their duties relating to environmental assessment, review of design and operating criteria, and review and approval of applications and contingency plans.

These *PEGs* supersede the previous (1994) version. Previous versions of these *PEGs* have been modified as a result of field experience, the quantity and quality of data available for an area, and advances in technology. The Regulator continues to be interested in new developments in any of these areas, and invites suggestions for future improvements to the *PEGs* which may be suggested by these developments. The present edition was developed through a consultative process including representation from Industry, government departments, consultants, and the International Ice Patrol (IIP). The Regulator encourages ongoing consultation.

1.1 Environmental Monitoring Program Development

The suggested approach of development of a Monitoring Program by an Operator, for a specific Installation, is depicted in Figure 1-1. Development of an offshore Monitoring Program using the suggested approach should facilitate the Operator's fulfillment of all regulatory requirements.

Figure 1-1 – Suggested Approach to Monitoring Program Development



The Operator may elect to meet regulatory requirements and these *PEGs* using another program development approach.

1.2 Environmental Monitoring Program Description

A description (the *Program Description*) of the weather, oceanographic, and ice programs, where appropriate, should be submitted either to the National Energy Board (NEB), to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) in the Newfoundland Offshore Area, or to the Canada Nova Scotia Offshore Petroleum Board (CNSOPB) in the Nova Scotia Offshore Area. For brevity, the generic term "Regulator" will be used in the remainder of this document. The Program Description should accompany the relevant application to the Regulator for authorization of drilling or production activities. Any changes to these programs, associated with a change in offshore Installation or location, should be noted in the drilling or production application and should be discussed with the Regulator as early as possible.

The Program Description should include, at least, the following information:

- An outline of the physical environment monitoring team, with roles and responsibilities identified;
- An outline of program management;
- An "high-level" summary of the meteorology, oceanography and ice monitoring program procedures (see Table 1-1);
- An outline of the meteorology, oceanography and ice forecasting programs;
- An outline of any forecast verification programs (see Appendix A);
- A description of quality assurance and data archival plans;
- The names, addresses, and description of the roles of any contractors involved in the program;
- A description of any unusual or non-standard features of the program, including, but not limited to, unattended or occasionally attended Installations and fully automated systems;
- A description of any substantive departures from these *PEGs*, with justification;
- A description of proposed equipment.

If operators wish to alter the spatial and temporal collection of data within their areas of operation, including multi-operator equipment/data sharing, the Program Description should include justification for the proposed changes. The Regulator will review such proposals on a case-by-case basis.

Table 1-1 – Monitoring Program Component Procedures

<u>Meteorology</u>	▪ Aviation Weather Observing ▪ Marine Weather and Sea State Observing ▪ Aviation Weather Reporting ▪ Marine Weather and Sea State Reporting
<u>Oceanography</u>	▪ Oceanographic Observing ▪ Oceanographic Reporting
<u>Ice Management</u>	▪ Ice Observing ▪ Ice Reporting ▪ Ice Detection

2.0 APPLICABLE REGULATIONS/LEGISLATION

These *PEGs* are governed by set regulations and legislation, which serve to form the basis of an offshore environmental program.

The latest version of all regulations, legislation, standards or codes referred to in these PEGs should be used in design and execution of physical environment programs. Operators of existing programs should consult with the Regulator if a transition period regarding a specific amendment appears to be required.

2.1 Meteorology

The following documents provide a basis for aviation weather, marine weather and sea state observing programs at an Installation:

- *CAR 804.1(c) MANOBS - Manual of Surface Weather Observations [1];*
- *MANMAR- Manual of Marine Observations* [5];
- *Annex 3 to The Convention on International Civil Aviation* [8];
- *Guide to the Provision of Meteorological Service for International Helicopter Operations* [20].

2.2 Oceanography

The results of the measurement programs are of most use when the data that are collected are consistent and complementary with those collected by other Operators and by government agencies operating in the same areas. Therefore, the standards of measurement and the documentation set out in these *PEGs* should be incorporated in the design of the Operator's program.

2.3 Ice Management

In regions where sea ice or icebergs are expected to occur, the Operator should prepare an *Ice Management Plan* for submission to the Regulator as part of the application for Drilling Program Authorization in the case of drilling, and the application for Production Operations Authorization in the case of production. Refer to Appendix B.

3.0 PROGRAM DESCRIPTION

3.1 Observations

The Operator is required, pursuant to the Regulations, to take meteorological, oceanographic and ice measurements during drilling and production programs on Frontier Lands.

Unless otherwise agreed to **in writing** by the Regulator, observations should be taken in accordance with these *PEGs*, and the standards and procedures referenced herein.. The Regulator, after consultation with the Operator and the appropriate government agencies, may exempt the Operator from those standards and procedures deemed not to be applicable to specific offshore operations.

The following environmental parameters should be observed and recorded daily:

a) The presence of any ice floes or icebergs and their movement;

b) At least once every three hours:

   i) Wind direction and speed,

   ii) Wave height period and direction,

   iii) Swell direction, height and period,

   iv) Current direction and speed

   v) Barometric pressure,

   vi) Characteristic of pressure tendency,

   vii) Air temperature,

   viii) Sea surface temperature,

   ix) Visibility,

   x) Wet bulb/dew point,

   xi) Present weather,

   xii) Cloud type, height and amount;

c) The pitch, roll and heave of floating installations;

d) Ocean temperature and salinity at the current measurement depths and times, when feasible.

Vessel response information about the pitch, roll and heave of the helideck is required to land a helicopter on a floating installation. The above list is further specified in this document.

3.2 Meteorology, Oceanography and Ice Observing

The following subsections outline the main features of offshore aviation and marine weather observing.

The Operator should be prepared to measure and make available additional oceanographic data as required by the Regulator to support marine safety and environmental protection (e.g. spill countermeasures or fate & effects assessments).

The Operator should ensure that oceanographic equipment that may be used for emergency events is tested periodically to ensure that it would be available for use and that it is operating within established parameters.

3.2.1 Parameters to be Observed

Parameters to be observed and/or reported are listed in Table 3-1.

Table 3-1 – Aviation and Marine Observing and Reporting Parameters

Parameter	Reported	Notes
Wind direction	Aviation / Marine	From which the wind is blowing, clockwise from true north in degrees (meteorological convention). 10 minute average for marine, 2 minute average for aviation
Wind speed	Aviation / Marine	10 minute average for marine, 2 minute average for aviation Gusts and squalls are reported for aviation but not for marine.
Mean sea level pressure	Aviation / Marine	Derived quantity
Pressure tendency	Aviation / Marine	3-hour pressure difference
Pressure tendency characteristic	Marine	MSL pressure time series trace required to determine this characteristic
Altimeter setting	Aviation	Derived quantity
Air temperature	Aviation / Marine	Required for mean sea level pressure and altimeter calculations
Air humidity (dew point and wet bulb temperature)	Aviation / Marine	Required for mean sea level pressure and altimeter calculations
Horizontal prevailing visibility	Aviation / Marine	
Cloud and ceiling heights	Aviation / Marine	
Cloud layer amounts	Aviation / Marine	
Cloud layer opacities	Aviation	
Cloud types	Aviation / Marine	
Vertical visibility	Aviation / Marine	
Precipitation intensity	Aviation / Marine	
Current atmospheric phenomena	Aviation / Marine	
Past weather types	Marine	
Heave, pitch and roll	Aviation	Required for floating installations. Included as a “remark” in the Aviation report.
Sea wave significant height	Marine	
Sea wave direction	Marine	
Sea wave average period	Marine	
Swell direction(s)	Marine	
Swell significant height(s)	Marine	
Swell average period(s)	Marine	
Maximum combined seas	Aviation/Marine	Included as a “remark” in the Aviation report
Wave spectrum peak period	Marine	
Sea surface temperature	Aviation / Marine	Included as a “remark” in the Aviation report
Ice accretion rate	Marine	
Ice accretion amount	Marine	
Ice / iceberg conditions	Marine	Basic information on ice / icebergs is required for marine observation

3.2.2 Oceanographic Parameters to be Observed

An oceanographic measurement program should be designed to meet the overall objectives of the monitoring program. In most instances the oceanographic monitoring measurements described in the following subsections should suffice.

3.2.2.1 Current Measurements

Ocean currents should be measured with a view to resolving their vertical structure and temporal variability during the program period. Ocean currents should be measured continuously at a minimum of three levels in the water column: near the surface in the wave zone, near mid-depth, and near the bottom. Unless otherwise approved by the Regulator, these measurements should be obtained from fixed mooring positions near the Installation.

3.2.2.2 Conductivity Temperature Depth Measurements

Pressure, temperature and salinity data provide information on water masses and density stratification, and complement water movement data provided by the velocity measurements. Regular measurements that resolve vertical and seasonal variability should be made, until sufficiency of available data has been clearly established. This could be accomplished by moored sensors at representative depths (such as the current measurement depths), or by acquiring regular CTD profiles at least once each season but preferably once each month.

3.2.2.3 Sea State Measurements

The following sea state parameters, as a minimum, should be measured:

- Significant wave height;
- Maximum wave height;
- Wave spectrum average and peak period; and,
- Wave spectrum.

Operators are encouraged to use instruments capable of measuring wave direction in addition to the above parameters.

3.2.2.4 Water Levels

The Operator should consult with the Regulator and the regional Canadian Hydrographic Service office to determine if tide measurements are required at their locations. If required, measurements should be made according to specifications of CHS [6] and these *PEGs*.

3.2.3 Ice Management Parameters to be Observed

Ice observations are essential for Installation safety and operations and for logistics support, and are a necessary source of information for strategic ice services groups, i.e. CIS and IIP. Sea ice and iceberg observations should be compiled as described in *MANMAR* [5], *MANICE* [3] and in the Operator's *Ice Management Plan*.

3.2.2.5 Ice Observing Personnel and Logistics

Installation: observations must be made by a qualified ice observer.

Supply Vessels: under the Safety of Life at Sea (SOLAS) agreement, ships must report all hazards to navigation. Vessel ice reconnaissance is an integral part of ice management.

Aerial Support: helicopter and other aircraft shall observe ice conditions, as they are able.

Observers should report ice for the radar and visual ranges experienced on their respective observation platform, e.g. drilling unit, ship, helicopter.

3.2.2.6 Sea Ice Parameters to be Observed

The manner in which pack ice information is recorded and reported should be described in detail in the Operator's *Ice Management Plan*, and be consistent with *MANICE* [3], *MANMAR* [5], and as described in Table 3-2.

Table 3-2 – Sea Ice Parameters

Parameter	Comments
Vessel information:	
Call sign	Unit or vessel identification, e.g. VOBL
Date-time	dd/mm/yy hhmm of observation (UTC)
Latitude, longitude	Degrees and decimal minutes for position of vessel reporting (0.1' accuracy as a minimum) e.g. 5030.2 N 5106.3 W
Ice Edge Positions:	
{range (nm), bearing (°T)}	Ice edge positions: a set of points delineating the ice edge relative to the observing vessel's position (0.01 nm accuracy)
Egg Code: Ice Concentration, Thickness, Floe Size	
Total concentration	Total concentration of sea ice of all types, together with three values, e.g. distinguished 'A', 'B', and 'C', for each of the parameters partial concentration, thickness, and floe size. Use MANICE egg code thickness and floe size codes.
Partial concentrations	
Thicknesses	
Floe sizes	
Drift direction (degrees toward, °T)	Ice floe drift direction, e.g. 160°
Drift speed (knots)	Ice floe drift speed
Radar range	The effective radar range at the time of the observation (nm)
Other (as per the Iceberg additional information Table 3-3): physical management, vessel, environmental, and other information (as available). The observer should note any additional information as appropriate and note units when there is any chance of confusion.	
Vessel course	Ship or aircraft heading (degrees toward)
Vessel speed	Ship or aircraft speed (knots or mph)

Parameter	Comments
Reconnaissance area	Description of area of coverage
Sea temperature (°C)	Environmental information relevant for sea ice modelling, tactical information relevant for physical management considerations, and potentially other support operations.
Wave height (m)	
Wave period (s)	
Wind speed (kt)	
Wind direction (degrees from)	
Current speed (kt or m/s)	
Current direction (degrees to)	
Sea ice concentration	
Sea ice thickness	

3.2.2.7 Iceberg Parameters to be Observed

The manner in which iceberg information is recorded and reported should be described in detail in the Operator's *Ice Management Plan*, and be consistent with *MANICE* [3], *MANMAR* [5], and as described in Table 3-3.

Table 3-3 – Iceberg Parameters

Parameter	Comments
Core iceberg information:	
Call sign	Unit or vessel identification, e.g. VOBL
Date-time (UTC)	dd/mm/yy hhmm of observation
Latitude, longitude (degrees and decimal minutes, 0.1' accuracy as a minimum, e.g. 5030.2 N 5106.3 W)	Position of iceberg target: for some observation reporting, it will be sufficient to report target range and bearing from the observer's location, e.g. on supply vessel
Size	Use IIP/CIS size classification codes. e.g. LB, BB
Shape	Use IIP/CIS shape classification codes, e.g. TAB, DOM
Confidence	Source of observation: radar, visual, or radar plus visual
Additional iceberg information (as available):	
Length (m)	Iceberg dimensions (m)
Width (m)	
Height (m)	
Draft (m)	
Drift direction (degrees toward)	Iceberg drift direction, e.g. 160°
Drift speed (knots)	Iceberg drift speed
Length method flag	An indication of the method used to obtain the iceberg

Parameter	Comments
Width method flag	length/width/height measurement, e.g. measured with camera or sextant, estimated, missing
Height method flag	
Draft method flag	An indication of the method used to obtain the draft, e.g. measured, estimated, grounded
Radar range (nm)	The effective radar range at the time of the observation
Other: physical management, vessel, environmental, and other information (as available). The observer should note any additional information as appropriate and note units when there is any chance of confusion.	
Deflection assessment	An assessment of the probability of successful deflection of this iceberg, e.g. 1-good, 2-fair, 3-poor, 4-impossible
Deflection type	Deflection method, if iceberg is presently being deflected, e.g. 1-tow, 2-water cannon, 3-prop wash, 4-other (specify)
Deflection heading	Direction toward which deflection is directed
Deflection force (tonnes)	
Evaluation of Tow Success (percent)	
Vessel course (degrees toward)	Ship or aircraft heading
Vessel speed (knots or mph)	Ship or aircraft
Reconnaissance area	Description of area of coverage
Sea temperature (°C)	Environmental information relevant for iceberg modelling, tactical information relevant for physical management considerations, and potentially other support operations. Report additional sea ice details as per Table 3-2.
Wave height (m)	
Wave period (s)	
Wind speed (kt)	
Wind direction (degrees from)	
Current speed (knot or m/s)	
Current direction (degrees to)	
Sea ice concentration	
Sea ice thickness	

3.3 Collection Specifications

Meteorological and oceanographic data measurements should be collected to the specifications recommended in Appendix C.

Averaging and recording intervals, and other required information, should be provided to the Regulator in a document file. A record specification should be included to define the layout of data records; variable and unit's identification, and record format specification. A completed equipment data sheet (see Appendix D) should be included with all data sets, as a component of the data set documentation.

3.4 Real-Time Meteorological, Oceanographic and Ice Reporting

Several types of physical environmental reports may be issued from, or sent to, an Installation in real-time.

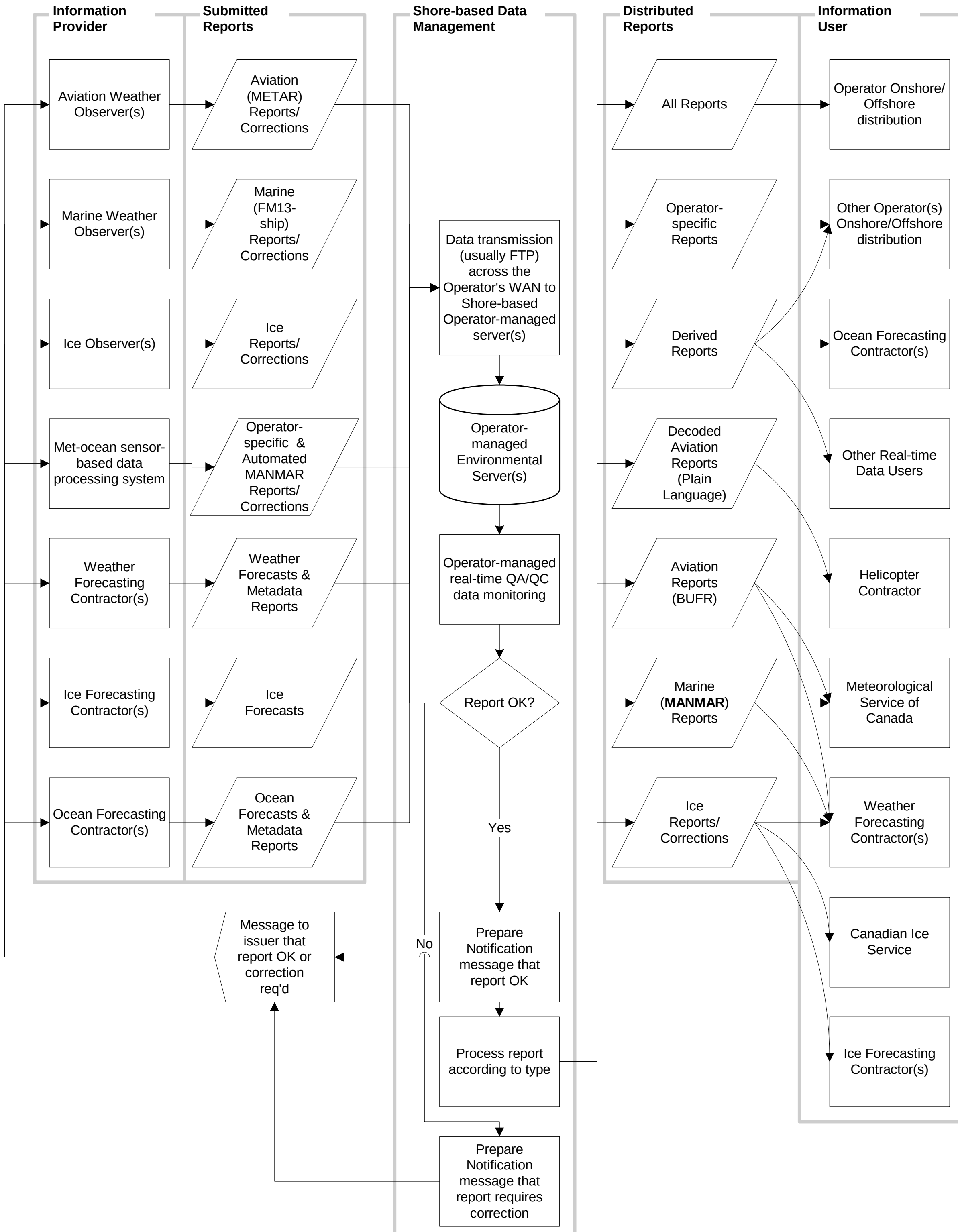
These include:

- Marine weather and sea-state reports (Synoptic ship reports);
- Aviation weather reports (ASCII text);
- Metadata reports (Appendix E);
- Ice reports (generally in the ICE format);
- Iceberg reports (generally in the ICEBERG format);
- Wave spectral data reports (generally in the WAVEOB format);
- Real time current reports;
- Site-Specific weather and sea state forecasts;
- Ice forecasts (sea ice and iceberg trajectory); and,
- Aviation terminal forecasts (in TAF format) if required.

Figure 3-1 depicts the flow of information to and from an Installation, and to information users for real-time data. There are a number of general points to be made in reference to this figure:

- There should be a single distribution channel for any report, from an information provider to an information user. The “single-point-of-failure” approach enables rapid tracing in the event of data disruption.
- Quality assurance and control procedures should be incorporated into all aspects of the reporting process: by the information provider, the information user, and within the data management system.
- Report delivery notification procedures should be a component of routine operations.
- Report correction procedures shall be implemented for all report distributions.
- Users of reports should be able to notify data managers of the disruption of report distribution on a 24-hour per day basis.
- Backup systems are required for the distribution procedures for all critical report.

Figure 3-1 – Real-time Reporting



3.4.1 Marine Weather Reporting

Marine weather observations will be provided with 24-hours per day coverage. As a minimum, synoptic ship observations will be provided every three hours with special reports as required. The operator should ensure that these reports are transmitted on a timely basis, within twelve (12) minutes of the observation when practical.

Operators are encouraged to use automated systems that will deliver instrument reported weather and / or sea state data to shore on the hour, and every 20 minutes during significantly changing weather and / or sea state conditions.

An operator may elect to report sensor derived (as opposed to manually recorded) data in WMO FM13 international sea station reporting code [16], provided that:

- Automated FM13 format reports are prepared and distributed in real-time to MSC on an hourly basis.
- Wind, temperature, humidity, and sea state sensors are routinely validated according to suitable quality assurance and control procedures.
- If equipment problems occur, bad data should be marked appropriately as missing and an updated Metadata report should be sent.
- There is a capability for manual observations to be taken on a 3 hourly basis should automatic reporting systems fail.
- The marine weather observer has the ability to add fields that are not sensor-derived.

As much sea state and related wind / weather data as possible should be provided in each report. Thus, all code groups should be considered as important. (See Appendix F)

3.4.2 Aviation Reporting

Aviation observations will be prepared by a qualified Aviation Weather Observer, on an hourly basis, on those days when helicopter flights are scheduled. The aviation observation program will be in operation at least during the period 0800 UTC until the last helicopter has landed on shore. It is recommended that aviation reports be issued either daily from 0800 UTC to 1900 UTC or, ideally, on a 24-hour basis. METAR / SPECI codeform is only acceptable for complete aviation weather observations. If the observations are not complete or if there is no SPECI program then an abbreviation of the METAR format (which will not include the word METAR within it) should be used. And, if SPECI are to be included, then it should state what criteria are being used for them.

A capability for performing aviation observing will exist at all times on the Installation. There must be at least two individuals capable of providing sufficient meteorological and helideck-condition information to helicopter pilots to safely land on the Installation at all times.

Aviation reports must be transmitted in METAR or SPECI report, if they are distributed to MSC. Other formats may be used for Operator-specific applications of aviation information. Note that the SAWRS-based aviation observations standard is obsolete and cannot be used.

3.4.3 Metadata Reporting

The Operator should ensure that the metadata described in Appendix E and I are collected. Meteorlogical metadata described in Appendix E will be delivered to MSC at or before the inception of the physical environmental program and in an accurate and timely fashion whenever changes occur.

3.4.4 Oceanographic Data Reporting

Oceanographic Data should be in an ASCII format or a WMO endorsed format; which should include some minimum metadata information (i.e. position, depth, time etc.) Binary data formats are not acceptable. ICES guidance on formatting is available at http://www.ices.dk/datacentre/guidelines/MDMguidelines/DataTypeGuidelines.asp

The Operator should describe its approach in real-time reporting of oceanographic data. The Operator is encouraged to collect real-time oceanographic data whenever possible.

3.4.5 Ice Reporting Procedures

In general, the formatting of ice observations and reports, and the frequency and means of distribution of this information, is left to the Operator, appropriate for their needs, and established in the *Ice Management Plan*. The exception to this is ice reports that must be provided to CIS, CCG, or IIP. Note that information received (from ships) by CCG is relayed to CIS. CIS and IIP share any information they receive. CIS routinely forward observations to CCG for marine navigation. Therefore, outside of Operator *Ice Management Plan* reporting procedures, including any reporting to the Regulator, reports to CIS should suffice.

Iceberg information should be forwarded to CIS in *MANICE* [3] ICE and ICEBERG formats, whenever possible. The essential requirement is timely ice reporting with as much detail as possible. Information received by CIS is coded into ICE and ICEBERG formats (if not already) as a precursor to input to their modelling and operations. Simple worded message formats should be used for any reports to CCG and IIP.

Relevant ice observation, reconnaissance, monitoring, and deflection reports must be provided to the Regulator in the event that ice enters the Installation's ice alert/response zones or in the event that the Operator undertakes an aerial reconnaissance for their area of interest.

Ice information should also be coded in the synoptic ship report and reported according to the marine weather reporting schedule.

The *MANICE* [3] Iceberg Message Code (ICEBERG) accommodates message header, reconnaissance track, individual, cluster, grid and zone observations, and ship location details.

Note that the reporting of no ice occurrence is valuable in itself. During ice season, vessels should report to the Installation Ice Observer any ice observed or explicitly the non-occurrence of ice. As well, the Ice Observer as part of his/her reporting should also note the absence of ice.

3.2.2.8 Timing

Supply vessels and aircraft, should report ice information (occurrence and non-occurrence) as part of their regular duties (e.g. at the end of a transit leg) as well as during specific reconnaissance assignments. As a minimum, this information should be conveyed to the ice observer on the installation. The vessel may elect to report observations to CCG or IIP.

For an Ice Observer on the Installation, during ice season, the exact timing and frequency of ice observing will be defined in the *Ice Management Plan*; however, as a minimum, a radar and visual ice watch should be maintained on a regular basis (several times per hour) especially with known ice in the area.

3.5 Equipment Requirements

Weather and sea state monitoring equipment should be "fit-for-purpose". This section describes equipment selection, installation and functional specifications.

3.5.1 Selection and Installation of Monitoring Equipment

Selection and installation of meteorological and sea state monitoring equipment is the responsibility of the Operator. Minimum accuracy specifications for equipment are provided in Appendix C.

Operators in a particular area are encouraged to pool their resources and to consult with the Regulator with a view to conducting combined measurement programs.

The MSC Port Meteorological Officer (PMO), or other qualified individual, should be consulted for information on the siting of meteorological sensors. The WMO [15] provides guidance for the siting of meteorological instruments.

The Operator should have the meteorological and oceanographic instrumentation at each offshore installation inspected by the MSC Port Meteorological Officer or a qualified independent third party before the installation commences its drilling or production program and the report submitted to the Regulator. Plans for ongoing inspections of this instrumentation should be detailed in the *Quality Assurance Program* described in Section 5.0.

3.5.2 Instruments

A variety of instruments and techniques may be used to satisfy the objectives of these *PEGs*. In addition, environmental conditions and site-specific requirements may vary from region to region, and measurement programs should be tailored for the particular geographic area of operation.

These *PEGs* do not specify the types of instrumentation that should be used by an Operator, but rather identify minimum standards with which the measurements should comply. Measurement programs should be described in sufficient detail and sufficiently far in advance to permit the Regulator to evaluate the suitability of the proposal to the exploration or development program under consideration.

An Operator intending to work in ice-infested or ice-covered waters, where conventional instrument deployment is difficult or impossible should consider the use of bottom-founded or remote sensing instrumentation.

The Operator is responsible to notify CCG of any and all instrument deployments and provide all relevant details as applicable including: nature and description of deployment, latitude, longitude, depths of sub-surface instruments, flasher duration (surface markers shall be outfitted with radar reflectors and a flasher). This information will be used by CCG to notify other mariners of the location of the instrumentation

3.5.3 Monitoring Equipment Specifications

Functional specifications and related considerations for monitoring equipment are provided in Appendix C. The Operator should complete and retain the equipment datasheet in Appendix D for each piece of monitoring equipment.

3.5.4 Integrated Reporting Equipment

Data integration systems, software and hardware, are used frequently offshore to manage and display data from meteorological and oceanographic sensors. It is the responsibility of the Operator to ensure, and be prepared to demonstrate, that all software calculations performed by meteorological and oceanographic data integration systems used in aviation weather and marine weather and sea state reports are correct.

3.5.5 Equipment Approval Process

Appendix G lists instruments that have been used on Frontier Lands in the past. It is not an approved list of equipment and the Operator is not restricted to use of this equipment. In the event that equipment has not been used in the offshore before, it is the responsibility of the Operator to demonstrate that meteorological and oceanographic equipment meets the functional specifications described in Appendix C.

3.5.6 New Technologies

New technology instrumentation may be capable of obtaining much more information than is possible using present conventional methods. Operators using this instrumentation therefore are encouraged to acquire and archive data in greater detail and at more frequent time intervals than specified in these *PEGs*. Diagnostic data also should be archived to permit the evaluation of data quality and integrity.

4.0 FORECASTING

Two types of weather forecast services are normally required: site-specific marine forecast services for normal and emergency conditions related to drilling or production operations; and aviation weather forecast services for support flights. In addition, in areas subject to sea ice or iceberg incursion, tactical ice forecasts are also required.

4.1 Site-Specific Marine Weather and Sea State Forecasting

The Operator must arrange for site-specific weather and sea state forecasts in support of its operations.

The Operator should ensure that its Weather Forecasting Contractor is familiar with the requirements for forecast services contained in the Operator's Contingency and Response Plans.

Essential elements of the site-specific forecast service include:

- Forecast issuance at least every 6 hours, or more frequently as required;
- Forecast preparation by a qualified meteorologist who has access to all available and appropriate meteorological and other data should maintain a continuous weather watch;
- Data sources should be sufficiently secure and redundant to enable guaranteed data access at all times;
- A forecast amendment service with defined forecast amendment criteria (threshold values);
- Forecast for each synoptic (i.e. 00, 06, 12, 18 UTC) hour in the forecast period of wind speed and direction, sea state (wave and swell height, period and direction), precipitation, visibility, sky conditions, air temperature, freezing spray and icing conditions (when appropriate); and a synopsis of present weather patterns;
- Forecasts should extend over, at least, a 48-hour period;
- An outlook covering the period from the last valid time of the forecast out to 120 hours should be included and should be more qualitative in content than the forecast;
- If a major departure from the MSC regional forecast appears warranted, the forecaster preparing the site-specific forecast should consult with the appropriate MSC Weather Centre;
- In the case of an emergency, special forecasts tailored to the emergency shall be prepared and updated as required; and,
- An effective data communications system is required to ensure the timely transmission and receipt of environmental data and forecasts.

4.2 Aviation Forecasting

TC requires that graphical area forecasts (GFAs) be available to support aviation services to offshore installations. These forecasts are provided by NAVCAN. Real time aviation observations from offshore installations, prepared according to the standards listed in Section 2.0, are required to support the preparation of GFAs.

The Operator may arrange for the provision of Aerodrome Forecasts (TAFs) from either a government or private forecast provider. These TAFs will be prepared in accordance with standards and procedures defined in *MANAIR*. The provider of TAFs to an Installation must meet regulatory requirements established by TC.

4.3 Ice and Iceberg Forecasting

The Operator should obtain forecasts of ice movements on a daily basis. The CIS ice charts are one such source of daily ice forecast information. As part of their *Ice Management Plan*, the Operator should have available sea ice and iceberg trajectory forecasting capabilities to address specific tactical requirements.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL

The Operator should develop and document a quality assurance and quality control (QA/QC) program to ensure:

- observing and reporting errors are minimized;
- data flow disruptions are as short in duration as possible;
- data-user requirements are being met;
- instruments comply with the required accuracy and in accordance with the manufacturer's specifications;
- any operability problem with an instrument is identified, reported and mitigated; and,
- the accuracy of seastate and ice forecasts.

5.1 Weather Observing Program

The QA/QC program for weather observation should include the following:

- competency testing of observers;
- intra-parameter and temporal consistency checking of observations;
- regular checking and monitoring, preventative maintenance or adjustments of instruments should be carried out by suitable trained staff;
- documented procedure for manual corrections of instrument readings;
- when the report is completed and ready for transmission, each item should be checked individually.

In addition, the QA/QC program for aviation weather observation should be developed with consideration of WMO *842* [20] and *MANOBS* [1]. The accuracy of measurements or observations should be in accordance with the guidance material in ICAO Annex 3 [8] (see Attachment B of that document), and these *PEGs*.

5.2 Weather and Sea State Forecast Verification

The Operator should develop a forecast verification program, as described in Appendix A, and review verification results at least monthly.

5.3 Ice Forecast Verification

The Operator should ensure that forecast verification is completed for all seasons in which tactical ice forecasting was conducted. This verification should be supported by as much detailed iceberg position and drift track observation and modeling information as possible.

6.0 TRAINING

6.1 Meteorologist

Only a Meteorologist can issue, modify or interpret offshore weather and sea state forecasts.

An Operator should ensure that a Meteorologist:

- Holds a university-level degree of equivalent;
- Has an appropriate level of knowledge of mathematics, physics, chemistry and computer science;
- Has completed an appropriate level of In house training at MSC or with a Weather Forecasting Contractor;
- Receives periodic and ongoing training in data and guidance assessment, and forecasting techniques; and,
- Receives periodic and ongoing training in the Operator's Contingency and Response Plans.

An Operator should ensure that its Weather Forecasting Contractor's in-house training program has been developed in consultation with MSC,

Marine meteorologists should have specialized training in the interpretation and limitations of numerical models (atmospheric and oceanographic) and forecasting techniques used in marine meteorology, sea state forecasting, and (as appropriate) forecasting in the marginal ice zone. Understanding of local weather and oceanographic features and patterns is highly desirable.

Aviation meteorologists (if required by the operator), should have the specialized training in aircraft icing, turbulence, other hazardous phenomena, meteorological aspects of flight planning, definitions, procedures for meteorological services for international air navigation, air traffic services, aerodromes, operation of aircraft, aeronautical information services, aeronautical telecommunications, WMO and ICAO documentation.

6.2 Weather Observer

The Operator is responsible to ensure the weather observer is competent and trained to make observations accurately and to code the resulting reports within the time allotted [1]. The observers must have completed training provided by a Weather Observer Instructor. Only trained observers can take marine or aviation weather observations.

The Operator should:

- Establish and document standards and methods for training;
- Maintain detailed training records for each trained person and provide each person with evidence of qualifications;

- Determine and set limitations on the tasks to be performed by personnel based on their training and demonstrated competence;

Should there be a requirement for an offshore weather observer to provide interpretive weather briefings, the Operator must ensure that the weather observer is suitably trained and qualified for these specific tasks. Otherwise, interpretation of meteorological forecasts and/or weather charts will be performed by a qualified meteorologist.

If the use of oceanographic equipment is necessary to properly prepare weather reports, the Operator should ensure that observers are trained appropriately for the equipment used on the installation.

6.2.1 Aviation Weather Observer

The Operator should consult with the Transport Canada regional office to ensure that the curriculum for the aviation weather observer training meets regulatory requirements regarding content, length of course and qualifications of weather observer trainers. TC can also provide documentation stating that the approach being taken meets the requirements subject to future audit and inspection. The MSC National Weather Observer Training Standard – Course Syllabus [10] could be used as a model for designing courses for offshore use. The training course should include, at a minimum, appropriate:

- Aviation observing program management;
- Quality assurance;
- Specification, calibration and maintenance of equipment;
- Observer-use of equipment;
- Aviation observing procedures;
- Reporting procedures;
- Data archiving procedures;

and provide for the testing and qualification of course participants.

6.2.2 Marine Weather Observer

Operators should ensure that personnel undertaking marine weather observations are trained in a manner suitable for the intended area of operations. Marine observing training should include appropriate:

- Marine weather monitoring program management;
- Quality assurance;
- Specification, calibration and maintenance of equipment;
- Observer-use of equipment;
- Weather, sea state and ice observing procedures;

- Reporting procedures;
- Data archiving procedures.

6.3 Ice Observer

An Operator should ensure that each Ice Observer is trained in:

- all aspects and elements of the Operator's *Ice Management Plan*;
- the relevant terminology, observations, ice chart, and ice and iceberg reporting messages chapters of *MANICE* [3] and *MANMAR* [5];
- ice monitoring, tracking and deflection techniques;
- ice characterization and reporting (including ice codes);
- the use of radar for ice detection; and,
- in radio communication.

6.4 Oceanographer

An Oceanographer is a graduate of a specified program in oceanographic studies at a recognized university. An Operator should ensure that analytical services related to oceanographic reports (Section 8.3.3) are provided by an Oceanographer.

7.0 REPORTS AND DATA

A summary of all reports and data associated with these *PEGs* is provided in this section.

It is the responsibility of the Operator to ensure that physical environmental reports and data identified in this Guideline are collected and delivered to the appropriate government agency and/or the Regulator.

7.1 Environmental Monitoring Program Description

The contents of this report are outlined in Section 1.2 of these *PEGs*. Operators should submit to the Regulator two paper copies and one electronic copy of the program description.

7.2 Ice Management Plan

In regions where sea ice or icebergs are expected to occur, the Operator should prepare an *Ice Management Plan* for submission to the Regulator as part of the application for Drilling Program Authorization in the case of drilling, or the application for Production Operations Authorization in the case of production. Refer to Appendix B. Operators should submit to the Regulator one paper and one electronic copy of the Ice Management Plan.

7.3 Physical Environment Report

The Physical Environmental Report should contain:

1. Meteorological Data Report;
2. Forecast Verification Report;
3. Oceanographic Data Report;
4. Ice Data Report (if applicable); and,
5. Equipment Inspection Reports.

Physical Environmental Reports respecting exploratory drilling programs should be submitted as part of the Final Well Report within 90 days of the well termination of the associated exploratory well. For development drilling and production programs, reports should be supplied to the Regulator annually, on a calendar year basis, by March 1st of the succeeding year. Operators should submit to the Regulator one paper and four electronic copies of the Physical Environmental Report. Operators are encouraged to amalgamate all meteorological, oceanographic and ice reports into one comprehensive document.

7.3.1 Meteorological Data Report

The report should include:

a) A description of any changes to the meteorological data collection and weather observing programs which occurred after the submission of the Environmental Monitoring Program Description report, as outlined in Section 1.2 of these *PEGs*;

b) Copies of all metadata reports which were submitted during the program;

c) Copies of all marine and aviation data observations on acceptable electronic data storage media;

d) Recommendations for change in any future measurement program;

e) A table of monthly extremes (maxima and/or minima) of all weather parameters observed or measured.

f) Copies of quality controlled meteorological sensor data as described in Table 7-1, on acceptable data storage media; and,

g) A description of the quality control program carried out on the data.

7.3.2 Forecast Verification Report

The report should include:

a) Weather forecast verification statistics as described in Appendix A of these *PEGs*;

b) Time series plots may be submitted on appropriate storage media and need not be reproduced in hard copy; and,

c) Electronic copies of all weather forecasts.

7.3.3 Oceanographic Data Report

The report should include:

a) A description of any changes to the oceanographic data collection that occurred after the submission of the Environmental Monitoring Program Description, as outlined in Section 1.2 of these *PEGs*;

b) Recommendations for change in any future measurement program;

c) Electronic copies of all metadata reports which were submitted during the program;

d) Quality controlled oceanographic sensor data (see Table 7-1), submitted to the Regulator on acceptable data storage media and in a format suitable for archiving at MEDS as described in Appendix H;

e) A current data report which contains an archival and an analysis section. The archival section should contain, at a minimum, a location diagram, bar chart, mooring or deployment diagrams, instrument log sheets/calibration curves, deployment/recovery logs, description of data editing procedures, and explanations of data gaps. The analysis section should provide an overview of the information extracted from the data records and include:

i. time series plots of current speed and direction, temperature, and salinity,

ii. progressive vector diagrams,

iii. harmonic analysis,

iv. spectral analysis,

v. bi-variate histograms,

vi. statistical summaries (maximum, minimum, mean, standard deviations),

vii. stick plots optional, and,

viii. persistence or exceedance diagrams optional;

f) A wave data report which contains an archival section (as in item e above) and an analysis section and should include, at a minimum:

i. Time Series of Wave Height and Period;

ii. Percent Exceedence of Significant Wave Height; and,

iii. Histogram of Peak Period and Mean Zero Crossing Period.

7.3.4 Ice Data Report

The report should include:

a) A description of any changes to the ice data collection which occurred after the submission of the Environmental Monitoring Program Description, as outlined in Section 1.2 of these *PEGs*;

b) Ice forecast verification statistics as described in Appendix A of these *PEGs*;

c) Ice data analysis;

d) Archived ice data on acceptable storage media, and in a format described in Appendix H; and,

e) Electronic copies of all ice forecasts.

7.3.5 Physical Environmental Data Reports and Measurements

Table 7-1 summarizes the minimum set of reports and measurements that should be contained within the Physical Environment Report.

Table 7-1 – Minimum Meteorological and Oceanographic Sensor Measurements

Parameter	Recording Interval	Notes
Metadata reports	As needed	**Appendices E and I**
Marine synoptic ship reports	3-hourly	**WMO FM13** report is transmitted in near real time.
Aviation (METAR) reports	as recorded	**METAR** report is transmitted in near real time.
Ice (ICE and ICEBERG) reports	as recorded	**ICE** and **ICEBERG** reports are transmitted in near real time.
10 minute averaged wind speed and direction	10 minutes	ASCII or any data format readable by a simple text editor
2 minute averaged wind speed and direction	Hourly	ASCII or any data format readable by a simple text editor
Significant wave height (Hs)	20 minute	ASCII or any data format readable by a simple text editor
Maximum wave height (Hmax)	20 minute	ASCII or any data format readable by a simple text editor
Average Period	20 minute	ASCII or any data format readable by a simple text editor
Wave spectrum	20 minute	ASCII or any data format readable by a simple text editor
Air Temperature – 1 minute averaged if using electronic sensor	Hourly	ASCII or any data format readable by a simple text editor
Dew-point or wet-bulb or relative humidity – 1 minute averaged if using electronic sensor	Hourly	ASCII or any data format readable by a simple text editor
Ocean currents (eastward and northward components)	See note[1]	ASCII or any data format readable by a simple text editor. Minimum near-surface, mid-depth and near-bottom required.
Ocean temperature and salinity	See note[2]	Instrument specific format including depth and time.

7.4 Equipment Inspection Reports

The report described in section 3.5.1 should be submitted to the Regulator and MSC prior to the inception of an offshore monitoring program. The report should include descriptions of the data collecting instrumentation which have been installed in accordance with these PEGs and calibration reports on each sensor.

1 Ocean currents should be measured at least once every 30 minutes with a view to resolving the vertical structure and temporal variability during the program period.

2 Regular measurements that resolve vertical and seasonal variability should be made, until sufficiency of data has been clearly established. This could be accomplished by moored sensors at representative depths (such as the current measurement depths), or by regular monthly (preferably) or seasonal CTD profiles.

8.0 REFERENCES

The latest version of all regulations, legislation, standards or codes referred to in these PEGs should be used in design and execution of physical environment programs. Operators of existing programs should consult with the Regulator if a transition period regarding a specific amendment appears to be required.

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[17] World Meteorological Organization, 2001: *Manual on Codes, International codes-Volume I.2 Part B: Binary codes and Part C: Common features to binary and alphanumeric codes, WMO Document No. 306,* 2001 Edition. WMO, Geneva.

[18] World Meteorological Organization, 1998: *Guide to Wave Analysis and Forecasting. WMO Document No. 702*, 1998 Edition. WMO, Geneva.

[19] World Meteorological Organization, 1994: *Guide to* WMO *Binary Code Forms. WMO World Weather Watch Technical Report No. 17*. WMO, Geneva. Available on the Internet.

[20] World Meteorological Organization, 1996: *Guide to the Provision of Meteorological Service for International Helicopter Operations. WMO Document No. 842.* Originating Authorities: International Civil Aviation Organization and World Meteorological Organization.

[21] World Meteorological Organization, 2000: *Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology, Preliminary issue of the fourth edition of WMO-N° 258, Vol. I – Meteorology.*

[22] World Meteorological Organization, 2002: *International List of Selected, Supplementary and Auxiliary Ships, WMO No. 47.* http://www.wmo.int/pages/prog/www/ois/pub47/pub47-home.htm

Appendix A

Forecast Verification

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A.1 Overview

Forecast verification is performed to enable offshore operators to assess the skill and reliability of the forecast program. Confidence in the forecast will enable the operator to use the forecast as guidance for making operational decisions.

In order to provide reliable forecasts and verification statistics it is incumbent on the operator to provide the forecasting contractor with access to accurate and timely observations.

Verification statistics are a measure of the agreement between forecasts and observations. Hence, they are an indication of the joint effectiveness of the observing and forecasting programs. Verification information should be updated and presented to forecast-users in as near real-time as possible.

The principal objectives of forecast verification are:

- evaluation of the accuracy of the forecasts;
- evaluation of the accuracy and representativeness of observations;
- investigation of trends in the forecasts, and thereby improvement of their quality; and,
- improved knowledge of the impact of weather and weather information on offshore operations, as a means of risk assessment.

It is recommended that a forecast verification analysis, as presented in this Appendix, be an integral component of the forecast program.

A.2 Recommended Parameters for Verification

The key parameters that impact on an offshore marine operation are wind speed, wind direction and wave height. It is recommended that these parameters, as a minimum, be verified for all forecast programs. Where tactical ice forecasts are required, predictions of ice or iceberg positions should be verified as well. Other parameters, such as air temperature and visibility may be worthy of consideration depending upon their importance to the operation.

The Operator is responsible for determining which forecast parameters are verified.

A.3 Observations

An observation value used for verification purposes should correspond as closely as possible with the corresponding forecast parameter definition (see next section). This correspondence may be difficult to achieve because of observation limitations due to imperfect siting of instruments, and other factors. Obstructions from the Installation superstructure and thermal effects, for example, can prevent instruments from recording ambient conditions.

For example, it may be necessary to:

- Remove any known bias from the observations. In the case of wind observations there may be both speed- and direction-dependent observational errors that should be removed before observations are used in a verification analysis.
- Apply any spatial and/or temporal averaging to match observation definitions with those of the corresponding forecast parameters.
- Apply any necessary adjustments to make observations and forecast reference the same height above sea level.
- Apply any necessary physical derivations. An example would be to verify humidity forecasts using dry-bulb and wet-bulb temperature measurements.

Further, observations used in the verification system must correspond in definition to the forecast parameters to be verified (see the next section). For example, the following formula may be used to process observations used in a verification system:

$$O_t = \frac{1}{5}\left(o_{t-3} + 3o_t + o_{t+3}\right) \qquad \textbf{Equation 1}$$

where the o_t are observed winds for the valid time ***t*,** 3 hours prior to the valid time, and 3 hours after the valid time. Marine wind observations (i.e. *MANMAR* [5] winds) may be processed using Equation 1, for example. Different expressions would be used if aviation observations or “sensor values” were used in the verification system.

A.4 Forecasts

Precise definitions of the forecast parameters being verified are required. That is, the following must be defined for each forecast parameter:

- the applicable horizontal and vertical spatial area;
- the vertical reference height;
- the temporal representativeness; and,
- the (sampling) averaging interval.

For example, 10-minute averaged forecast winds valid at an anemometer height of 60 metres, may be verified. The forecast winds may represent a 6-hour time period centred on the forecast valid time, according to the averaging formula:

$$F_t = \frac{1}{5}\left(f_{t-3} + 3f_t + f_{t+3}\right) \qquad \textbf{Equation 2}$$

where the f_t are forecast 10-minute-average winds for the valid times ***t*,** 3 hours prior to, and 3 hours after the valid time. The definitions of forecast parameters should be well known to all users of the forecast.

A.5 Time Series Plots

A set of monthly time-series plots of forecast and observed parameters is a recommended component of the verification. As discussed in Section A.3 any calculations required to make observations and forecasts correspond shall be performed prior to plotting. Plots for the 12, 24, 36 and 48 hour forecast lead times may be plotted. For the purposes of verification, lead times shall be based on the date/time of the latest completed synoptic analysis upon which the forecast is based. For example, a forecast issued at 240700 UTC, based upon a 240000 UTC synoptic analysis, shall have a 36 hour validation time at 251200 UTC. Consistent vertical and time axes should be used. It is useful to plot any operational threshold values on the time-series plots.

A.6 Verification Statistics

A set of verification statistics is recommended. The following statistics are described in the following sub-sections:

- Error
- Bias
- Mean Absolute Error
- Root Mean Square Error
- Skill Score

A.6.1 Error

The difference between the forecast and the observation, at a given time *t*, is given by:

$$E_t = F_t - O_t$$ **Equation 3**

The forecast error is given by:

$$E_t^f = F_t - T_t$$ **Equation 4**

and the observing error is:

$$E_t^o = O_t - T_t$$ **Equation 5**

where T_t is the "true value," that is, the value that would be measured by an unbiased (i.e. perfect) instrument. The above definitions for error show that:

$$E_t = E_t^f + E_t^o$$ **Equation 6**

That is, both the forecast and the observation have error components. Observation errors should be removed, if possible, before observations are used in a verification system. Otherwise the verification statistics unduly reflect errors in both the observation and forecast programs. Observation error assessment is an observing program quality assurance procedure.

A.6.2 Bias

The bias is given by:

$$BIAS = \frac{1}{N}\sum_{t=1}^{N}\left(F_t - O_t\right) \quad \textbf{Equation 7}$$

The bias indicates the average of the deviation of the forecast from the observations. The bias can be either negative or positive. Bias is a measure of the "direction" (i.e. positive or negative) but not the magnitude of the errors, and should be near zero.

A.6.3 Mean Absolute Error

The mean absolute error (MAE) is given by:

$$MAE = \frac{1}{N}\sum_{t=1}^{N}\left|F_t - O_t\right| \quad \textbf{Equation 8}$$

This statistic gives a measure of the average magnitude of errors, but does not indicate the direction of the errors. The MAE is always positive and less than or equal to the root mean square error.

A.6.4 Root Mean Square Error

The root mean square error (RMSE) is given by:

$$RMSE = \sqrt{\frac{\sum_{t=1}^{N}\left(F_t - O_t\right)^2}{N}} \quad \textbf{Equation 9}$$

This statistic also gives a measure of the average magnitude of errors, and does not indicate the direction of errors. Compared to the MAE, the RMSE gives greater weight to large errors than to small errors in the average. That is, if RMSE is much greater than MAE then a high frequency of large errors is indicated. It is therefore an appropriate statistic to use when large errors are particularly undesirable. This statistic encourages "hedging," as a forecaster can reduce the RMSE by forecasting in the mid-range of possible outcomes (i.e. not predicting extreme values).

A.6.5 Skill Score

The skill score is given by:

$$SS = \frac{R - E}{T - E} \quad \textbf{Equation 10}$$

where:

R is the number of correct forecasts
T is the total number of forecasts
E is the number expected to be correct based on climatological values for the given area derived from hindcast marine wind and wave data (for example AES40 hindcast data [13]) for the local area.

Note that:

SS = *1* when all forecasts are correct;
= *0* when number correct is equal to expected; and,
= a negative value when the forecast has negative skill with reference to knowledge of the local climate.

The skill score thus defined, expresses as a decimal fraction the percentage of forecasts which are correct after those forecasts have been eliminated from consideration which would have been correct on the basis of the knowledge of local climate.

Characteristics of the Skill Score are:

- The range of the skill score is from +1 to –minus infinity, where minus infinity is mathematically possible with a perfect standard forecast (E=T and E>R) and is independent of how accurate the actual forecast has been (only limitation E>R).
- The better the climatological data standard, the smaller the skill score for a set number of forecasts. Also the smaller the set of forecasts, the more likely the standard will, by accident, be very good and hard to beat.
- Where two different skilled forecast techniques are applied to a representative set of data, the one yielding the larger positive score will be the more useful.
- The skill score is a good parameter for comparing forecasts from different climate regions.
- The skill score is primarily a summary score.

In summary, the skill score is sensitive to the climatological figure used in the calculation. However, it is an important indicator in the assessment of forecasting accuracy. A score between zero and one indicates that forecasts are skillful relative to climatology.

A.7 Threshold Analysis

Threshold values are defined to establish operational requirements. The Operator generally wants to know the accuracy of forecasts against agreed operational thresholds. The selection of the threshold for wind speed and wave height should be related to the area of operation, type of facility, and the nature of critical operations. The Operator, in conjunction with the contractor, should select the thresholds for which the forecast verifications will be undertaken.

To obtain meaningful results, a threshold analysis should be calculated on the basis of a reasonable time frame that will provide a sufficient number of threshold-exceeded events. For longer drilling or production programs the statistics should be calculated on a seasonal basis, while for shorter (1 to 4 months) drilling programs the duration of the drilling or production program may be a more reasonable time frame for the calculations.

In the threshold analysis, forecast and observed values are allocated to one of four contingencies:

- Forecast correctly predicts that the threshold value is exceeded.
- Forecast correctly predicts that the threshold value is not exceeded.
- Forecast incorrectly predicts that the threshold value is exceeded (false alarm).
- Forecast incorrectly predicts that the threshold value is not exceeded (missed event).

The probability of detection, false alarm rate and missed event rate are obtained from a contingency table (Table A-1). The aim is to achieve as high a probability of detection as possible while keeping the missed event and false alarm rates as low as possible. The false alarm rate equates to unnecessary cost, while the missed event rate has both cost and safety implications.

The threshold contingency table is given by Table A-1.

Table A-1 - Threshold Analysis Contingency Table

		Forecast (*f*)		
		Threshold exceeded	Threshold not exceeded	Totals
Observed (*o*)	Threshold exceeded	$T_{o>=t}^{f>=t}$	$T_{o>=t}^{f<t}$	$N_{o>=t}$
	Threshold not exceeded	$T_{o<t}^{f>=t}$	$T_{o<t}^{f<t}$	$N_{o<t}$
	Totals	$N_{f>=t}$	$N_{f<t}$	N_{total}

where:

o =Observed value.
f =Forecast value.
t =Threshold value.
$T_{o>=t}^{f>=t}$ =Number of times observed value exceeds threshold, and forecast value exceeds threshold.
$T_{o>=t}^{f<t}$ =Number of times observed value exceeds threshold, and forecast value does not exceed threshold.
$T_{o<t}^{f>=t}$ =Number of times observed value does not exceed threshold value, and forecast value exceeds threshold.
$T_{o<t}^{f<t}$ =Number of times observed value does not exceed threshold, and forecast value does not exceed threshold.
$N_{f>=t}$ =Number of times forecast exceeds threshold (and similarly for the other totals)

The following subsections describe useful threshold verification statistics.

A.7.1 Percent Correct

The percent correct (*PC*) is given by:

$$PC = \frac{T_{o>=t}^{f>=t} + T_{o<t}^{f<t}}{N_{total}} \times 100$$ **Equation 11**

The range of this statistic is zero to 100.

A.7.2 Probability of Detection

The probability of detection (*POD*) is a measure of the ability of the forecast program to successfully predict the "threshold exceeded" event.

The *POD* is given by:

$$POD = \frac{T_{o>=t}^{f>=t}}{N_{o>=t}}$$ **Equation 12**

The range of this statistic is zero to 1.

A.7.3 False Alarm Rate

The false alarm rate (*FAR*) is a measure of the incorrect prediction of the "threshold exceeded" event.

The *FAR* is given by:

$$FAR = \frac{T_{o<t}^{f>=t}}{N_{o>=t}}$$ **Equation 13**

The range of this statistic is zero to 1.

A.4.4 Missed Event Rate

The missed event rate (*MER*) is a measure of the incorrect prediction of the "threshold not exceeded" event.

The *MER* is given by:

$$MER = \frac{T_{o>=t}^{f<t}}{N_{o>=t}}$$ **Equation 14**

The range of this statistic is zero to 1.

Appendix B

Ice Management Program

ICE MANAGEMENT PROGRAM

B.1 Overview

An ice management program is required for operations taking place in regions in which sea ice and/or icebergs can occur.

The Ice Management Program should include:

- detection,
- surveillance,
- data collection,
- reporting,
- forecasting, and
- avoidance or deflection.

B.2 Ice Management Plan Elements

The Operator should prepare and implement an ice management plan appropriate for the planned operations. Since ice conditions can vary greatly from area to area, and season-to-season, or year-to-year within an area, the ice management plan should be tailored to the region, period, and nature of the operation.

The ice management plan should be simple, functional, and provide guidance and a plan for action. The plan should address to some appropriate level of detail, the following critical factors:

<u>Operations Plan and Operating Environment</u>

- Operations details including any or all of: rig type, mode of station keeping, drilling season, well duration, re-supply plans, crew transport plans, etc.
- Description of physical environment conditions including sea ice, icebergs, marine climatology, physical oceanography, etc. The essential elements to describe are historical sea ice and iceberg conditions.

<u>Ice Management Principles, Strategy, Approach</u>

- corporate philosophy towards ice management and toward risk acceptance
- strategy objectives should be defined, e.g.
    - protection of crew and unit,
    - minimizing disruption or added expense to operations due to ice conditions.
- approach should be defined, e.g.
    - iceberg monitoring (surveillance + observations + tracking + forecasts)

- ice alertness with zone definitions to determine response
- ice response: e.g., physical management such as towing and/or deflection; disconnect and departure from wellsite.

Regional Strategic Surveillance

- seasonal outlook
- zone of interest
- opportunistic surveillance
- dedicated surveillance
- remotely-sensed surveillance
- frequency of surveillance
- detectability/target verification
- time applicability

Local Tactical Surveillance and Observation

- aerial surveillance
- vessel-based surveillance
- rig-based surveillance
- detection
- ancillary information
- continuity
- roles/responsibilities

Reporting and Information Management

- reporting/recording tools
- level of automation
- quality control
- communications
- information dissemination
- data sharing

Determination of Risk

- incident command and control
- roles and responsibilities
- tactical ice forecasting
- definition of ice management response zones

Response

- safety considerations
- interaction with drilling operation
- roles and responsibilities
- physical ice management

B.3 Joint Ice Management

As part of ice management planning, the Operator should explore existing or potential synergies with other operators and ice service groups regarding joint ice management. Potential practical benefits may exist in the areas of surveillance, observation, iceberg tracking, data sharing, tactical support, ice forecasting and trajectory modeling, and physical management.

B.4 Ice Reports

The Operator's Ice Management Plan should describe arrangements for reporting to the Regulator for all relevant ice observation, reconnaissance, monitoring, and deflection activities both on a routine basis and when dictated by any significant events.

As part of, or in addition to, the reporting defined in the Ice Management Plan, the Operator shall report:

- ice messages coded as per *MANMAR* [5]
- iceberg messages coded as per *MANICE* [3] (i.e. in **ICEBERG** format)

Appendix C

Monitoring Equipment Specifications

Table C-1 – Monitoring Equipment Specifications

Accuracy Specifications			Collection Specifications[3]	
Sensor	Accuracy	Sensor Requirements	Averaging Intervals	Recording Intervals
Wind Speed	± 1 kt up to 20 kts ± 5% for speed > 20 kts	• resistance to icing[4] • capability to digitally estimate 10-minute and 2-minute averages (preferable vector averages) • operation over full temperature range (for region in which equipment used) • capability to digitally estimate 1-minute and 1-hour averages (preferably vector averages) **Suggested:** • digital output (real time or archival) capability	1 minute (suggested) 2 minute 10 minute 1 hour (suggested)	10 minutes (10 minute average, hourly otherwise)
Wind Direction	± 5 degrees	As per wind speed	As per wind speed	As per wind speed
Pressure	± 0.1 hPa (barometer reading) ± 0.2 hPa (sea level pressure[5]) ± 0.01 hPa (QNH altimeter setting)	• capability to display 3-hour time trace required for tendency characteristic • operation over full temperature range (for region in which equipment installed[6]) **Suggested:** • digital output (real time or archival) capability	Instantaneous	1 minute
Air Temperature	± 0.1 degrees Celsius	• operation over full temperature range (for region in which equipment used) **Suggested:** • digital output (real time or archival) capability	1 minute	1 minute
Humidity (wet bulb)	± 0.1 degrees Celsius	• operation over full temperature range (for region in which equipment used) **Suggested:** • digital output (real time or archival) capability	1 minute	1 minute
Cloud Height	± 10 m up to 100 m ± 10% from 100 m to 300 m ± 20% for above 300 m	• operation over full temperature range (for region in which equipment used) **Suggested:** digital output (real time or archival) capability	1 minute	1 minute
Cloud Amount	1 okta (1/8th of the sky) if instrumentation is in use	• operation over full temperature range (for region in which equipment used) **Suggested:** • digital output (real time or archival)	1 minute	1 minute

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1 Sensor model/serial number, sensor height, siting description, record specification, trip report (if required), local chart datum (if required), equipment data sheet

2 Resistance to icing means "continued operation during light to moderate icing conditions."

3 Derived pressure readings depend on parameters additional to barometer reading, including temperature readings and height of barometer above mean sea level.

4 Barometers may not be exposed to the full range of temperatures that an installation may experience if installed in a heated area.

Accuracy Specifications			**Collection Specifications**[3]	
Sensor	Accuracy	Sensor Requirements	Averaging Intervals	Recording Intervals
		capability		
Visibility	± 50 m up to 500 m ± 10% from 500 m to 1500 m ± 20% for beyond 1500 m if measured by instrument	• operation over full temperature range (for region in which equipment used) **Suggested:** • digital output (real time or archival) capability	1 minute	1 minute
Wave Height	± 3% for periods 2 to 20 s ± 6% for periods 21 to 30 s	• operation over range 0 to 30 m • recording interval between 17.5 and 35 minutes • continuous recording interval height criteria reached • digital output (real time or archival) capability	Combined Significant Wave Height 20 minutes Maximum Wave Value 20 minutes Wave Spectral Period 20 minutes Wave Spectra 20 minutes	Combined Significant Wave Height 20 minutes Maximum Wave Value 20 minutes Wave Spectral Period 20 minutes Wave Spectra 20 minutes
Wave Direction(s)	± 5 degrees	• recording interval between 17.5 and 35 minutes • continuous recording interval height criteria reached • digital output (real time or archival) capability		
Sea Surface Temperature	± 0.5 degrees Celsius	• operation over range of –2°C to 25°C	1 minute	1 minute[7]
Water Level	± 0.01 metre	• digital output (real time or archival) capability • operation over full temperature range (for region in which equipment used)	10 minutes	1 hour
Water Temperature	± 0.5 degrees Celsius	• digital output (real time or archival) capability • operation over full temperature range (for region in which equipment used)		No longer than ½ hour for moored measurements, and monthly (preferably) or seasonally for CTD profiles
Salinity	± 1 part per thousand	• digital output (real time or archival) capability • operation over full salinity range (for region in which equipment used)		No longer than ½ hour for moored measurements, and monthly (preferably) or seasonally for CTD profiles
Depth	± 0.2 metre	• digital output (real time or archival) capability		No longer than ½ hour for

7 Recording and averaging intervals for obtaining sea surface temperatures will require further discussion. This is attributed to past history, the overall design of an offshore installation and the effectiveness of measuring temperature from an installation or standby vessel.

Accuracy Specifications			Collection Specifications[3]	
Sensor	Accuracy	Sensor Requirements	Averaging Intervals	Recording Intervals
		• operation over full depth range (for region in which equipment used)		moored measurements, and monthly (preferably) or seasonally for CTD profiles
Ocean Currents: horizontal current speed and direction	± 0.02 m/s for range 0–3 m/s ± 5° for range 0-360°	• record at near-surface, mid-depth and near-bottom depths • apply averaging intervals of at ≥ 5 minutes		No longer than ½ hour
Heave, pitch and roll	As provided	• Equipment provided by the Operator		

OCEANOGRAPHIC

Mooring Considerations

Moorings or deployments should be maintained in one location for as long as possible and need not be moved with every relocation of an Installation in a particular area. Consideration should be given to mooring or deployment longevity rather than relocation, whenever possible. Both the location and design of the moorings or deployment should be included in the Program Description described in Section 1.2.

The wave measuring instrument should be located so that the wave field being measured is not disturbed by the Installation and located sufficiently close to the Installation so that reliable communications between the wave instrument and the receiver on the Installation are maintained. The instrument should also be located so that the wave field being measured is not substantially altered from that at the site of the Installation because of sheltering, bottom effects, etc., or in general have a different exposure to prevailing conditions.

ICE MANAGEMENT

Instruments for ice detection and monitoring primarily include radar, which are generally operated from a drilling unit, ship, or aircraft. Instruments should be selected to optimize performance in a number of areas, including: range, target size detection and detection of small ice masses, detection in poor weather and sea conditions, and target tracking. *In situ* measurements of above-surface iceberg size are generally obtained using camera or sextant. Sonar and other underwater equipment, ROV or AUV, are generally used for draft measurement.

The Operator is encouraged to discuss existing or potential instrument and detection and measurement technologies with other operators and ice service groups to ensure that the most appropriate tools are used.

Appendix D

Monitoring Equipment Data Sheet

Overview

All physical environmental equipment used offshore should be documented using equipment data sheets.

All entries of the Data Sheet should be filled in, if possible. All Data Sheet data should be provided in digital form (WordPerfect™, Microsoft Word™, or ASCII formats are acceptable), for inclusion in the Physical Environmental Report.

Data Sheet Form

MEASURED PARAMETERS & ASSOCIATED MONITORING EQUIPMENT			
Item	Requirement	Description	See Note
	GENERAL		
1	Manufacturer		
2	Model Number		
3	Supplier		
4	Type of Equipment		
5	Construction		
6	Mounting & Adjustment		
7	Accessories		
	PERFORMANCE STANDARDS		
8	Accuracy		
9	Operating Temperature		
10	Measurement Range		
11	Response Time		
12	Mean Time Between Failures		
13	Response to Obstructions		
	ELECTRICAL REQUIREMENTS		
14	Hazardous Area Classification		
15	Power Supply		
16	Platform Electrical Frequency		
17	Output Signals		
18	Connection Details		
	ENVIRONMENTAL		
19	Ingress Protection (e.g. IP, NEMA)		
20	Typical Environmental Conditions		
	MAINTENANCE		
21	Test Methods		
22	Manuals		
	QUANTITY & TAGGING		
23	Quantity		
24	Tag Numbers		
	DOCUMENTATION		
25	Certification		

Appendix E

Meteorological Metadata Report Format

Meteorological metadata is collected so that better use can be made of the data Adjustments can be made to account for inhomogeneities in the data record, if changes in the instruments are known.

WMO Publication No. 47 (Pub47), the *International List of Selected, Supplementary and Auxiliary Ships,* [22] http://www.wmo.int/pages/prog/www/ois/pub47/pub47-home.htm contains details about the names, call signs, layout, and types of instrumentation and methods of observation used on VOS ships. The reader should contact MSC for updates to this information.

The information may be reported in tabular format as given here, and/or in semi-colon delimited ASCII text format with all fields on one line. Previous records for the platform should be included, as well as a separate note indicating the field(s) that have changed, to prompt the update to the metadata report. The information is to be provided in electronic format readable by a simple text editor and suitable for printing. Fields that are not applicable should be left blank (for tabular format) or indicated as missing by consecutive delimiters (for the semi-colon delimited ASCII text format). Significant changes to the parameters should be reported to MSC in as near to real-time as possible, e.g. changes to the anemometer height (e.g. due to different water depth, for a anemometer on the leg of a jack-up, or change in position of the instrument), call sign. Meteorological Metadata Reports should be transmitted to the Meteorological Service of Canada (MSC) via email: National.Climate.Archive.Services@ec.gc.ca.

Table E-1: Proposed new delimited format for transmitting Pub47

Order	Field Code Name	Explanation	Table	Format	Example
1	`rcnty;`	Recruiting country.	E-2	2 letter code	CA
2	`ver;`	Version of Pub47 format.			03
3	`Prepared;`	Date of report preparation.		ddmmyyy	
4	`name;`	Ship's name.			
5	`reg;`	Country of registration.	E-2	2 letter code	CA
6	`call;`	Call sign or WMO Number. Some sea stations are identified by a WMO Number instead of a call sign.			
7	`IMOn;`	IMO Number. Unique identifying number assigned by Lloyd's Register to the hull of the ship.			
8	`vssl;`	Vessel type.	E-3		
9	`vsslP;`	Vessel digital image.	E-4		
10	`lenvsslD;`	Length overall of the ship, ignoring bulbous bow.		0.0 m	
11	`brdvsslD;`	Moulded breadth. The greatest breadth amidships.		0.0 m	
12	`frbvsslD;`	Freeboard. The average height of the upper deck above the maximum Summer load line.		0.0 m	
13	`drfvsslD;`	Draught. The average depth of the keel below the maximum Summer load line.		0.0 m	
14	`chtvsslD;`	Cargo height. Maximum height above the maximum Summer load line.		0.0 m	
15	`brdg;`	Distance of the bridge from the bow.		0.0 m	

Order	Field Code Name	Explanation	Table	Format	Example
16	`rte;`	Route No. 1.	E-5		
17	`rte;`	Route No. 2.	E-5		
18	`rte;`	Route No. 3.	E-5		
19	`rte;`	Route No. 4.	E-5		
20	`rte;`	Route No. 5.	E-5		
21	`rte;`	Route No. 6.	E-5		
22	`rte;`	Route No. 7.	E-5		
23	`rte;`	Route No. 8.	E-5		
24	`rte;`	Route No. 9.	E-5		
25	`rte;`	Route No. 10.	E-5		
26	`vosR;`	Recruitment date of the current VOS participation.		ddmmyyyy	
27	`vosD;`	De-recruitment date of the last VOS participation (report only if the vessel has been re-recruited).		ddmmyyyy	
28	`vclmR;`	Last VOSClim recruitment date if within the current period of VOS participation.		ddmmyyyy	
29	`vclmD;`	Last VOSClim de-recruitment date if within the current period of VOS participation.		ddmmyyyy	
30	`vsslM;`	Type of meteorological reporting ship.	E-6		
31	`atm;`	General observing practice.	E-7		
32	`freq;`	Scheduled observing frequency.	E-8		
33	`prST;`	Satellite system for transmitting reports.			INMARSAT-C
34	`logE;`	Name and version of the electronic logbook software.			TurboWin 2.12
35	`wwH;`	Visual wind/wave observing height.		0.0 m	
36	`anmU;`	General wind observing practice.	E-9		
37	`blc;`	Baseline check of the automatic weather station.	E-10		
38	`awsM;`	Make and model of the automatic weather station.			Vaisala Milos 500
39	`awsP;`	Name and version of the automatic weather station processing software.			Yourlink 1.03.20
40	`awsC;`	Name and version of the automatic weather station data entry/display software.			Milos 500 2.56
41	`barm;`	Primary barometer type.	E-11		
42	`barm;`	Secondary barometer type.	E-11		
43	`bMS;`	Make and model of the primary barometer.			Vaisala PTB220B
44	`bMS;`	Make and model of the secondary barometer.			
45	`brmH;`	Height of the primary barometer above the maximum Summer load line.		0.0 m	
46	`brmH;`	Height of the secondary barometer above the maximum Summer load line.		0.0 m	
47	`brmL;`	Location of the primary barometer.	E-12		
48	`brmL;`	Location of the secondary barometer.	E-12		
49	`brmU;`	Pressure units of the primary barometer.		hPa	hPa

Order	Field Code Name	Explanation	Table	Format	Example
50	`brmU;`	Pressure units of the secondary barometer.			
51	`brmC;`	Most recent calibration date of the primary barometer.		ddmmyyyy	
52	`brmC;`	Most recent calibration date of the secondary barometer.		ddmmyyyy	
53	`thrm;`	Dry bulb thermometer type No. 1.	E-13		
54	`thrm;`	Dry bulb thermometer type No. 2.	E-13		
55	`thMS;`	Make and model of the dry bulb thermometer No. 1.			Rosemount ST401
56	`thMS;`	Make and model of the dry bulb thermometer No. 2.			
57	`thmE;`	Exposure of the dry bulb thermometer No. 1.	E-14		
58	`thmE;`	Exposure of the dry bulb thermometer No. 2.	E-14		
59	`thmL;`	Location of the dry bulb thermometer No.1 and hgyrometer No. 1.	E-15		
60	`thmL;`	Location of the dry bulb thermometer No.2 and hgyrometer No. 2.	E-15		
61	`thmH;`	Height of the dry bulb thermometer No. 1 and hygrometer No. 1 above the maximum Summer load line.		0.0 m	
62	`thmH;`	Height of the dry bulb thermometer No. 2 and hygrometer No. 2 above the maximum Summer load line.		0.0 m	
63	`tscale;`	General reporting practice for dry bulb thermometer No. 1 and hygrometer No. 1.	E-16		
64	`tscale;`	General reporting practice for dry bulb thermometer No. 2 and hygrometer No. 2.	E-16		
65	`hygr;`	Hygrometer type No. 1.	E-17		
66	`hygr;`	Hygrometer type No. 2.	E-17		
67	`hgrE;`	Exposure of the hygrometer No. 1.	E-14		
68	`hgrE;`	Exposure of the hygrometer No. 2.	E-14		
69	`sstM;`	Primary method of obtaining the sea surface temperature.	E-18		
70	`sstM;`	Secondary method of obtaining the sea surface temperature.	E-18		
71	`sstD;`	Depth of the primary sea surface temperature observation below the maximum Summer load line.		0.0 m	
72	`sstD;`	Depth of the secondary sea surface temperature observation below the maximum Summer load line.		0.0 m	
73	`barg;`	Primary barograph type, or method of determining pressure tendency.	E-19		
74	`barg;`	Secondary barograph type, or method of determining pressure tendency.	E-19		
75	`anmT;`	Primary anemometer type.	E-20		
76	`anmT;`	Secondary anemometer type.	E-20		
77	`anmM;`	Make and model of the primary anemometer.			Vaisala WAV151 & WAA151

Order	Field Code Name	Explanation	Table	Format	Example
78	anmM;	Make and model of the secondary anemometer.			
79	anmL;	Location of the primary anemometer.	E-21		
80	anmL;	Location of the secondary anemometer.	E-21		
81	anDB;	Distance of the primary (fixed) anemometer from the bow.		0.0 m	
82	anDB;	Distance of the secondary (fixed) anemometer from the bow.		0.0 m	
83	anDC;	Distance of the primary (fixed) anemometer from the centre line.		0.0 m	
84	anSC;	Side indicator of the primary (fixed) anemometer from the centre line, if appropriate.	E-22		
85	anDC;	Distance of the secondary (fixed) anemometer from the centre line.		0.0 m	
86	anSC;	Side indicator of the secondary (fixed) anemometer from the centre line, if appropriate.	E-22		
87	anHL;	Height of the primary (fixed) anemometer above the maximum Summer load line.		0.0 m	
88	anHL;	Height of the secondary (fixed) anemometer above the maximum Summer load line.		0.0 m	
89	anHD;	Height of the primary (fixed) anemometer above the deck on which it is installed.		0.0 m	
90	anHD;	Height of the secondary (fixed) anemometer above the deck on which it is installed.		0.0 m	
91	anmC;	Most recent calibration date of the primary anemometer.		ddmmyyyy	
92	anmC;	Most recent calibration date of the secondary anemometer.		ddmmyyyy	
93	othI;	Other meteorological/oceanographic instrument No. 1.	E-23		
94	othI;	Other meteorological/oceanographic instrument No. 2.	E-23		
95	othI;	Other meteorological/oceanographic instrument No. 3.	E-23		
96	othI;	Other meteorological/oceanographic instrument No. 4.	E-23		
97	othI;	Other meteorological/oceanographic instrument No. 5.	E-23		
98	othI;	Other meteorological/oceanographic instrument No. 6.	E-23		
99	chgd;	Last date of change of any Pub47 metadata.		ddmmyyyy	
100	fieldabbrev;	Code name of the field to which footnote No. 1 applies.	E-24		vssl
101	fieldabbrev;	Code name of the field to which footnote No. 2 applies.	E-24		othI
102	fieldabbrev;	Code name of the field to which footnote No. 3 applies.	E-24		brmL
103	fieldabbrev;	Code name of the field to which footnote No. 4 applies.	E-24		othI
104	fieldabbrev;	Code name of the field to which footnote No. 5 applies.	E-24		
105	fieldabbrev;	Code name of the field to which footnote No. 6 applies.	E-24		
106	fieldabbrev;	Code name of the field to which footnote No. 7 applies.	E-24		

Order	Field Code Name	Explanation	Table	Format	Example
107	`fieldabbrev;`	Code name of the field to which footnote No. 8 applies.	E-24		
108	`fieldabbrev;`	Code name of the field to which footnote No. 9 applies.	E-24		
109	`fieldabbrev;`	Code name of the field to which footnote No. 10 applies.	E-24		
110	`footID;`	Footnote No.1 (Mandatory free-form detail whenever code OT is reported. Optional for other codes).	E-24		Jack-up oil rig
111	`footID;`	Footnote No.2 (Mandatory free-form detail whenever code OT is reported. Optional for other codes).	E-24		Vaisala CT25K Ceilometer
112	`footID;`	Footnote No.3 (Mandatory free-form detail whenever code OT is reported. Optional for other codes).	E-24		Radio Room
113	`footID;`	Footnote No.4 (Mandatory free-form detail whenever code OT is reported. Optional for other codes).	E-24		Vaisala FD12P Present Weather Sensor
114	`footID;`	Footnote No.5 (Mandatory free-form detail whenever code OT is reported. Optional for other codes).	E-24		
115	`footID;`	Footnote No.6 (Mandatory free-form detail whenever code OT is reported. Optional for other codes).	E-24		
116	`footID;`	Footnote No.7 (Mandatory free-form detail whenever code OT is reported. Optional for other codes).	E-24		
117	`footID;`	Footnote No.8 (Mandatory free-form detail whenever code OT is reported. Optional for other codes).	E-24		
118	`footID;`	Footnote No.9 (Mandatory free-form detail whenever code OT is reported. Optional for other codes).	E-24		
119	`footID;`	Footnote No.10 (Mandatory free-form detail whenever code OT is reported. Optional for other codes).	E-24		

The following tables E-2 through E-24 are provided to assist the user with the completion of Table H-1.

Table E-2: `rcnty` – Recruiting Country and reg - Country of registration

Use two letter codes, i.e. Canada = CA. For more information consult www.wmo.ch/web/www/ois/pub47/pub47-home.htm

Table E-3: `vssl` – Vessel type

BA	Barges, including crane barges and tank barges
CA	Cable ships
DR	Dredgers including bucket, hopper, grab and suction dredgers
FP	Floating Production and Storage Units
FV	Fishing Vessels including purse seiners, long liners etc., but excluding trawlers
GT	Liquefied gas carriers/tankers including LNG and LPG carriers
IC	Icebreaking vessels (dedicated vessel). If the vessel fits in another category and is ice strengthened then include ‘ice strengthened’ as a footnote
LT	Liquid tankers including oil product tankers, chemical tankers and crude oil tankers (including VLCC’s and ULCC’s)
LV	Light vessels
MI	Mobile installations including mobile offshore drill ships, jack up units, semi-submersibles
PI	Pipe Layers
RV	Research Vessels, including oceanographic, meteorological and hydrographic research ships and seismographic research ships
SV	Support vessels including offshore support vessels, offshore supply vessels, stand-by vessels, pipe carriers, anchor handling vessels, buoy tenders (including coastguard vessels engaged solely on buoy tending duties), diving support vessels, etc.
TR	Trawler fishing vessels
TU	Tugs, including fire-fighting tugs, salvage tugs, pusher tugs, pilot vessels, tenders etc
OT	Other (specify in footnote)

Table E-4: `vsslP` – Vessel digital image

AV	Available in separate digital file. The file naming convention is: 00 – IMO Number – photo_description – Date (ANSI format, i.e. yyyymmdd), e.g. 007417868aerial_starboard_profile_from_stern20030717.jpg
NA	Not available
PA	Photograph available, but not yet scanned and placed in separate digital file

Table E-5: `rte` – Routes 1 to 10

The following routes apply to Canadian recruited platforms is an abbreviated list. Please consult www.wmo.ch/web/www/ois/pub47/pub47-home.htm with MSC regarding the new list which will be published in the revised version of Pub47 for updated lists.

8	EASTERN CANADIAN COASTAL WATERS
9	WESTERN NORTH ATLANTIC WATERS
10	GULF OF ST. LAWRENCE
11	BAY OF FUNDY
12	CABOT STRAIT
16	NORTHUMBERLAND STRAIT
28	WESTERN CANADIAN COASTAL WATERS
29	EASTERN NORTH PACIFIC WATERS
41	WESTERN CANADIAN ARCTIC WATERS

Table E-6: `vsslM` - Type of meteorological reporting ship

10	Selected
40	Supplementary
70	Auxiliary
OT	Other (specify in footnote)

Table E-7: `atm` - General observing practice

1	Fully automated
2	Always supplemented by manual input
3	Occasionally supplemented by manual input
4	Unknown
5	Fully manual (no automation)

Table E-8: `freq` - Scheduled observing frequency

OPD	One observation per day (24 hour intervals)
TPD	Two observations per day (12 hour intervals)
FPD	Four observations per day (6 hour intervals)
EPD	Eight observations per day (3 hour intervals)
HLY	Hourly observations
IRR	Irregular observations

Table E-9: `anmU` – General Wind Observing Practice

1	Anemometer measurement generally used, true wind computed
2	Anemometer measurement generally used, true wind manually determined
3	Visual estimates (sea state) generally used
4	Visual estimate generally used for the open sea, anemometer used near port

Table E-10: `blc` - Baseline check of the automatic weather station

1	Yes
2	No
3	No automation

Table E-11: `barm` - Barometer type

AN	Aneroid barometer (issued by Port Meteorological Officer or Meteorological Agency)
DA	Digital aneroid barometer
ELE	Electronic digital barometer (consisting of one or more pressure transducers)
MER	Mercury barometer
SAN	Ship's aneroid barometer
OT	Other (specify in footnote)

Table E-12: `brmL`- Location of the barometer

CR	Chart room
PW	Pressurised wheelhouse
WH	Wheelhouse, not pressurised
OT	Other (specify in footnote)

Table E-13: `thrm` - Dry bulb thermometer type

ALC	Alcohol thermometer
ELE	Electric (resistance) thermometer
MER	Dry Bulb mercury thermometer

Table E-14: `thmE` and `hgrE`- Exposure of the dry bulb thermometer and hygrometer

A	Aspirated (Assmann type)
S	Screen (non ventilated, i.e. natural ventilation)
SG	Ship's sling
SL	Sling
SN	Ship's screen (property of the ship)
US	Unscreened
VS	Screen (ventilated, i.e. assisted ventilation)
W	Whirling psychrometer

Table E-15: `thmL` - Location of the dry bulb thermometer and hygrometer

1	Bridge wing port
2	Bridge wing starboard
3	Bridge wing both sides
4	Bridge wing windward side
5	Wheelhouse top port
6	Wheelhouse top starboard
7	Wheelhouse top both
8	Wheelhouse top center
9	Wheelhouse top windward side
10	Mainmast
11	Foremast
12	Mast on Wheelhouse top
13	Main deck port side
14	Main deck starboard side
15	Main deck both sides
OT	Other (specify in footnote)

Table E-16: `tscale` - General reporting practice for dry bulb thermometer and hygrometer

1	Centigrade to tenths
2	Half degrees centigrade
3	Whole degree Centigrade
4	Whole degree Fahrenheit
5	Fahrenheit to tenths
6	Dry bulb centigrade, wet bulb Fahrenheit
7	Dry bulb Fahrenheit, wet bulb centigrade
OT	Other combinations or scale (specify in footnote)

Table E-17: `hygr` - Hygrometer type

E	Electric
H	Hair hygrometer
P	Psychrometer
Hg	Hygristor
C	Capacitance
T	Torsion
Cm	Chilled mirror
OT	Other (specify in footnote)

Table E-18: `sstM` - Method of obtaining sea surface temperature

BTT	Bait tanks thermometer
BU	Bucket thermometer
C	Thermometer in condenser intake on steam ships, or inlet engine cooling system on motor ships
HC	Hull contact sensor
HT	Through hull sensor
RAD	Radiation thermometer
TT	Trailing thermistor
OT	Other (specify in footnote)

Table E-19: `Barg` - Primary barograph type, or method of determining pressure tendency

OS	Open Scale barograph
OS1	Open Scale barograph with 1 day clock
OS2	Open Scale barograph with 2 day clock
OS3	Open Scale barograph with 3 day clock
OS4	Open Scale barograph with 4 day clock
OS5	Open Scale barograph with 5 day clock
OS6	Open Scale barograph with 6 day clock
OS7	Open Scale barograph with 7 day clock
OS8	Open Scale barograph with 8 day clock
OS9	Open Scale barograph with 9 day clock
SS	Small Scale barograph
ET	Tendency obtained from an electronic digital barometer
OT	Other (specify in footnote)

Table E-20: `anmT` – Type of Anemometer

AN	Anemograph
CCV	Cup anemometer and wind vane (combined unit)
SCV	Cup anemometer and wind vane (separate instruments)
HA	Handheld anemometer
PV	Propeller vane
SON	Sonic anemometer
OT	Other (specify in footnote)

Table E-21: `anmL` - Location of anemometer

1	Not fitted
2	Mainmast
3	Mainmast port yardarm
4	Mainmast starboard yardarm
5	Aft mast
6	Foremast
7	Foremast port yardarm
8	Foremast Starboard yardarm
9	Meteorological mast
10	Mast on wheelhouse top
11	Mast on wheelhouse top port yardarm
12	Mast on Wheelhouse top starboard yardarm
13	Handheld
OT	Other (specify in footnote)

Table E-22: `anSC` - Side indicator of the anemometer from the centre line

P	Port
S	Starboard

Table E-23: `othI` - Other meteorological/oceanographic instrument

BAT	Bathythermometer
BT	Bathythermograph (towed)
FLM	Fluorometer
HA	Hand held anemometer
LWR	Long wave radiation
MAX	Maximum thermometer
MIN	Minimum thermometer
NTE	Nitrate sensor
NTT	Nutrient sensor
P	Pilot balloon equipment
CO2	pCO2 system
PLK	Plankton recorder
PRS	Photosynthetic radiation sensor
PYG	Pyrogeometer
R	Radiosonde equipment
RG	Rain gauge
RSD	Radar storm and meteorological
RT	Reversing thermometer
SKY	Sky camera
SLM	Solarimeter
ST	Sea thermograph
SWR	Short wave radiation
SON	Sonic anemometer
TSD	Temperature/salinity/depth probe
TUR	Turbidity sensor
W	Radiowind or radarwind equipment
XBT	Expendable bathythermograph
OT	Other (specify in footnote)

Table E-24: `fieldabbrev` - Code name of the field to which footnote applies

`fieldabbrev (1-10)`	Code name of the field to which the footnote, in the equivalently positioned footID, applies. It is used to convey: (1) additional detail whenever the code OT is selected from a code table, or (2) to provide additional comment about ANY field that is selected from a table. e.g. `vssl`
`footID (1-10)`	Supplementary detail in free-form text, pertaining to the field specified in the equivalently positioned `fieldabbrev`. e.g. jack-up rig

Appendix F

Marine Weather Reporting Notes

The following information is provided to assist with the implementation of the FM13 code.

Installations are particularly encouraged to include the maximum number of data groups in Section 2 of FM13.

Particular attention should be paid to code groups 1PwaPwaHwaHwa and 70HwaHwaHwa. These code groups are to be used when instrumental wave data is available. Code group 70HwaHwaHwa is to be used as well when instrumental wave data is available to an accuracy of 0.1 m.

Code group 2PwPwHwHw is only to be used when non-instrumented wind wave information is being reported.

These wave encode parameters may be found in code 3155 in WMO Publication 306 Volume 1 page I.1-c-95.

Specific information on encoding important wave data is available in WMO Publication 306 Volume 1, page I.1-A-17.

Special Phenomena – Hurricane and Squall Winds

See also WMO Publication 306 Manual on Codes Volume II page II-4-A.1-2 section 4/12.14.2. The following group should be included by all stations when appropriate.

When, due to a hurricane or tropical storm, the maximum one-minute average wind speed between two times of observation exceeds 34 knots, the value of this maximum one-minute average wind speed should be included, together with the time of its occurrence, in the following form, added at the end of Section 3 of the synoptic report: ONE-MINUTE MAXIMUM . . . . KNOTS AT . . . . (hour, minute) UTC. A maximum two-minute average wind speed is acceptable providing the remark clearly indicates TWO-MINUTE MAXIMUM.

Appendix G

Equipment List

GENERAL

This is not intended to be an approved list of equipment. It is provided to give the Operator information regarding the types of instruments which have been used in the offshore in the past. It is incumbent upon the Operator to ensure that all proposed instrumentation is appropriate for use in the area of operation, that it meets the functional specifications as described in Appendix B, and to document its capabilities in the Program Description prior to use. Operators are encouraged to evaluate new technologies as they become available.

Note i: g.f. = “grandfathered” equipment. Although the equipment may be used as part of an existing system, it may not be added as part of a new system.

Note ii: Temperature and pressure instruments require calibration certificates and correction cards issued by an acceptable laboratory.

Note iii: Wave radar systems must be calibrated to ensure proper functioning. Systems that are new to Canada or that are proposed for substantially different locations than previous usage, may need to be verified against an alternate wave measurement system.

METEOROLOGICAL INSTRUMENTS

Cloud Height

[1] MSC Ceiling Projector 16 with alidade (500 ft or 1000 ft baseline)
[2] Vaisala CT25K with acceptable display
[3] Vaisala CT12K with acceptable display
[4] MSC Ceiling Balloons with balloon filling equipment (using helium or hydrogen)

Visibility

[1] Vaisala FD12P Visibility/Weather Sensor, Vaisala
[2] Visibility Chart Form 0063-9046 that has been completed and approved by qualified meteorological inspector.
[3] Suitable map that has been approved by qualified meteorological inspector

Occurrence of Weather Phenomena

[1] Ice Accretion Indicators

Atmospheric Pressure

[1] Ruska 6220 (with desiccant cartridge if used for inspection)
[2] Druck DPI140
[3] Paroscientific Digiquartz 760-16B (station and inspection)
[4] Paroscientific Digiquartz 6016B
[5] Solartron DPM 7885 (with desiccant cartridge)
[6] Vaisala PTB220A (3 transducers, Class A calibration)
[7] MSC Type Barograph (and recording charts)

Temperature/Humidity

Note: Temperature and Dew Point values obtained from thermometers shall be located in a ventilated Stevenson Screen type shelter. Specifications for thermometers require that the scale error at any point in the range does not exceed 0.2ºC. Additionally, readings from thermometers paired for a psychrometer should read within 0.2ºC of each other under like conditions.

<u>Temperature</u>
[1] RTD-87 MSC Remote-Temperature Dew-Point System (1987) with display
[2] Vaisala HMP 45A with 2212 HM solar radiation shield, Vaisala
[3] Vaisala HMP 45D with 2212 HM solar radiation shield, Vaisala
[4] Yellow Springs Instruments Model 44212 Thermistor (must have conditioning electronics)
[5] MSC Ordinary Mercury Thermometer with correction card
[6] MSC Sling Psychrometer
[7] MSC Minimum Thermometer

<u>Temperature (Estimated T-12 as per MANOBS)</u>
[1] Thermograph or Lambrecht Thermohygrograph

<u>Humidity</u>
[1] RTD-87 MSC Remote Temperature Dew-Point System (1987) with Display
[2] Vaisala HMP 45A with 2212 HM solar radiation shield, Vaisala
[3] Vaisala HMP 45D with 2212 HM solar radiation shield, Vaisala
[4] MSC Ordinary or Ordinary for Sling Mercury Thermometer with correction card
[5] MSC Type A-E Dewcel
[6] MSC Sling Psychrometer

Wind Direction and Speed

<u>Measured Wind Direction and Speed</u>
[1] MSC Type U2A Anemometer, 110 or 32 Volt system with approved chart recorder or indicator
[2] MSC Type 78D Anemometer with approved recorder or indicator
[3] Vaisala WAA251 Heated Anemometer, Vaisala
[4] Vaisala WAV151 Heated Wind Vane, Vaisala
[5] Obsermet OMC-150 Anemometer, Obsermet AS

<u>Estimated Wind Direction and Speed</u>
[1] Beaufort Wind Scale
[2] TurboMeter hand held, Davis Instruments
[3] AMES RVM 96B Hand Held Anemometer, AMES
[4] g.f. Anemometer, Lambrecht, hand held, 0 - 60 knots

OCEANOGRAPHIC INSTRUMENTS

Sea State
[1] Datawell Standard Waverider, Datawell
[2] Datawell Directional Waverider, Datawell
[3] MIROS Wave Radar, SM-050, MIROS A/S
[4] Triaxys Directional Wave Buoy, AXYS Environmental Systems
[5] Oceanor Seawatch Buoy, Oceanor ASA
[6] Oceanor Wavescan Buoy, Oceanor ASA
[7] WaMoS II Wave Radar, Sea-Image Communications Ltd

Sea Surface Temperature
[1] Triaxys Directional Wave Buoy (with electronic SST thermometer), AXYS Environmental Systems
[2] MSC sea water bucket and sea surface thermometer

Ocean Currents and/or Conductivity, Temperature, Depth (CTD)
[1] MIROS Wave Radar SM-050, MIROS A/S (surface currents)
[2] RDI Acoustic Doppler Current Profilers, RD Instruments
[3] Aanderaa Doppler Current Meter, DCM 12, Aanderaa
[4] Aanderaa Recording Current Meter, RCM 8/9, Aanderaa
[5] InterOcean S4/S4A/S4P/S4D Current Meter, InterOcean
[6] Aanderaa Conductivity / Temperature Profile Recorder CTR 7, Aanderaa
[7] Sea-Bird 911/911plus CTD, Sea-bird Electronics
[8] Sea-Bird SBE 25 Sealogger CTD, Sea-bird Electronics
[9] RDI WorkHorse Long-Ranger ADCP (75 kHz), RD Instruments
[10] RDI Narrow-Band Self-Contained ADCP (150 kHz), RD Instruments
[11] Aanderaa Acoustic Current Meter, RCM11
[12] Falmouth Scientific FSI ACM
[13] Seabird MicroCAT SBE 37-SM
[14] Sippican Inc XCTD
[15] Sippican Inc XBT-10

Water Level
[1] Aanderaa Water Level Recorder, WLR 7/8, Aanderaa

ICE MONITORING INSTRUMENTS

Iceberg Draft
Imagenex 855-000-110 Color Imaging (Sector Scan) Sonar, Imagenex

Appendix H

Recommended Data Format

Data Formats

The essential requirements for data formats are:

- All key information is included,
- An appropriate format is selected, and
- Complete documentation is specified.

The following categories of formats are recommended:

- WMO character-based and binary formats, and
- ASCII or any data format readable by a simple text editor.

WMO formats are used for marine, aviation and ice observations that are distributed to government and Industry agencies in real-time. ASCII or any data format readable by a simple text editor formats are used when the nature of the data to be archived is not practically served by one of the other formats.

<u>Summary of Report and Data Product Formats</u>

Table A-1 summarizes formats for each of the possible reports or data products that may be used in a Monitoring Program. Wherever possible, standard data formats should be used. A description of the different format types is provided in the following sections.

Table H-1 - Formats for Reports and Data Products

Report or Data Product	Recommended Format
Aviation Weather Report	ASCII
Marine Weather Report	FM-13
Ice Report	ICE
Iceberg Report	ICEBERG
Wave Spectral Data Report	ASCII or any data format readable by a simple text editor
Ocean Current Data Reports	ASCII or any data format readable by a simple text editor [1]
Sensor data used for Installation-specific operations	ASCII or any data format readable by a simple text editor
Sensor data to be shared between Installations	At Operator's discretion
Miscellaneous Data	ASCII or any data format readable by a simple text editor

1 Current data from conventional moored instruments or moored Acoustic Doppler Current Profiler (ADCP) instruments may be submitted in either ASCII or any data format readable by a simple text editor, provided that all of the essential support documentation described in Appendix I on Current Meter Metadata Report Format is provided.

WMO Formats

The Canadian, *MANAIR* [2], *MANOBS* [1] and *MANICE* [3] manuals use WMO-developed and maintained character-based formats for the coding of marine, aviation and ice reports. These reports are distributed on Canadian and international telecommunications circuits.

The **FM-13** format is used to code marine weather and sea state observations. The **ICE** format is used to code ice data. These data should be archived in these WMO formats.

There is also a WMO character-based format for coding wave spectra data from sea sensor systems. The WMO FM 65-IX **WAVEOB** format can be used to distribute wave spectral data in real-time. This information is useful for determining the response of floating vessels to wave conditions.

Appendix I

Current Meter Metadata Report

Based on ICES Guidelines
http://www.ices.dk/datacentre/guidelines/MDMguidelines/DataTypeGuidelines.asp [9]

General

Raw and quality controlled data should, whenever possible, be stored at the original sampling frequency.

All parameters and units must be clearly specified and described. If parameter codes are used, then the source data dictionary must be specified. Parameter scales must be noted where applicable. If computed values are included, the equations used in the computations should be stated.

All relevant calibrations should be applied to the data including laboratory and field calibrations. Instrument calibration data should be included in the data file. The data should be fully checked for quality and flagged for erroneous values such as spikes, gaps, etc. An explicit statement should be made on the checks and edits applied to the data. If any data values have been removed, the times of the removed values should be noted.

In particular:

- All data values should be expressed in oceanographic terms, which should be clearly stated.
- Depending on the method of measurement, current velocity may be expressed in terms of speed and direction and/or in terms of east and north components.
- A clear statement should be made on whether or not the data have been corrected for magnetic variation - if the correction has been made then the magnetic variation that was assumed should be stored alongside the data.
- The time zone in use should be clearly stated and each data cycle should include date/time of observation (without loss of precision). It is recommended that UTC be used.
- Other parameters measured as part of the series, e.g. temperature, pressure, conductivity, should be included with the data.
- An estimate of uncertainty in the final data should be included.

A brief description of the data calibration, quality and processing (manufacturers and in-house) should be included and contain information regarding:

- Filtering, de-spiking, or smoothing methods
- Editing or quality control methods
- Interpolation techniques
- Adjustments made due to variations in calibration

Collection Details

Collection

- Country and organisation responsible for the deployment, recovery, collection and processing of the data. The name of the project leader should be included.
- Project, ship, mooring type, mooring number
- Originator's reference numbers/identifiers for mooring and series
- Dates and times of each instrument deployment and recovery (UTC)
- Dates and times of start and end of usable data for each instrument (UTC)
- Latitude and longitude, method of position fix (e.g. DGPS, GPS, etc.)
- Water column depth (specify method e.g. sounding, chart, etc.)
- Instrument depth (or height, specify which)

Mooring

- Brief description of mooring structure
- Performance of mooring including condition on recovery, whether dragged or damaged and any event that might have affected the data (e.g. wave action, knockdown, etc.)

Instrument – Conventional Moored

- Instrument description - manufacturer, instrument type, model, serial number, additional sensors
- Type of sampling (e.g. instantaneous, averaged, burst recording)
- Time interval between successive data cycles in the series
- Original sampling interval - for cases where the processed observation is derived/extracted from higher resolution data (optional)
- Accuracy, resolution and response range of individual sensors
- Standard of calibration, e.g. method, quality, dates, calibration coefficients
- Instrument modifications if any

If applicable:

- Number of raw data samples used in processed value
- Methods of averaging, filtering or compression

Instrument – Moored ADCP

- Instrument description - manufacturer, instrument type, model, serial number, additional sensors, number of transducers
- Description of operational procedures including sampling interval (time between ensembles), pings per ensemble, bin size, number of bins, percentage good level, automated data rejection (e.g. fish rejection algorithms), etc.
- Frequency (kHz), band type (broad, narrow), heads facing upward or downward
- Parameters collected (e.g. u and v velocity components, vertical velocity, error velocity, echo intensity, percent good pings)
- Multiplicative and/or additive scale factors where applicable
- Instrument modifications if any

Report on data quality

Any additional information of use to secondary users which may have affected the data or have a bearing on its subsequent use (e.g. effects of near surface buoyancy, sea state, fouling, etc.) should be included.

Appendix J

Contact Information

Fisheries and Oceans Canada Contacts

Area	Address	Area Code	Phone Number	Fax Number
Canada	Director Marine Environmental Data Service Department of Fisheries and Oceans Suite 1202, 200 Kent Street Ottawa, Ontario, K1A 0E6	613	990-0265	993-4658
Atlantic	Regional Advisory Process Office Bedford Institute of Oceanography P.O. Box 1006 Dartmouth, Nova Scotia, B2Y 4A2	902	426-9920	426-5435
Québec	Director General Quebec Region Department of Fisheries and Oceans P. O. Box 15500 Quebec, Quebec, G1K 7Y7	418	648-4014	648-4470
Canada	Director, Hydrography Canada Centre for Inland Waters Bayfield Institute 867 Lakeshore Road P.O. Box 5050 Burlington, Ontario, L7R 4A6	905	336-4811	336-8916
Pacific and Arctic	Chief, Data Assessment Division Institute of Ocean Sciences P. O. Box 6000 Sidney, British Columbia, V8L 4B2	604	363-6335	363-6479

Environment Canada Contacts

Area	Address	Area Code	Phone Number	Fax Number
Atlantic	Regional Director General Environment Canada, Atlantic Region 15th Floor, Queen Square 45 Alderney Drive Dartmouth, Nova Scotia, B2Y 2N6	902	426-6700	426-2690
Atlantic	Regional Director Meteorological Service of Canada, Atlantic Region 16th Floor, Queen Square 45 Alderney Drive Dartmouth, Nova Scotia, B2Y 2N6	902	426-9120	426-3256
Québec	Directeur général régional Environment Canada, La région du Québec 1141 rue de l'Eglise Sainte-Foy, Québec, G1V 4H5	418	648-4077	649-6213
Ontario	Regional Director General Environment Canada, Ontario Region 4905 Dufferin St. Downsview, ON, M3H 5T4	416	739-4666	739-4691
Prairie and Northern	Regional Director General Environment Canada, Prairie and Northern Region Twin Atria Building 4999 - 98 Avenue, 2nd Floor Edmonton, Alberta, T6B 2X3	780	951-8869	495-3086

Area	Address	Area Code	Phone Number	Fax Number
Pacific and Yukon	Regional Director General Environment Canada, Pacific and Yukon Region 201 – 401 Burrard St. Vancouver, British Columbia, V6C 3S5	604	664-9145	664-9190
Canada	Director General Atmospheric Monitoring and Water Survey Directorate Meteorological Service of Canada 4905 Dufferin Street Downsview, Ontario, M3H 5T4	416	739-4965	739-4261
Canada	Canadian Ice Services Meteorological Service of Canada 373 Sussex Drive La Salle Academy, Block E Ottawa, Ontario, K1A 0H3	613	996-5088	996-4218
Canada	Ice Operations Meteorological Service of Canada 373 Sussex Drive La Salle Academy, Block E Ottawa, Ontario, K1A 0H3	613	996-4552	996-4218
Canada	For transmission of Meteorological Data and Meteorological Metadata: National.Climate.Archive.Services@ec.gc.ca			

Transport Canada Contacts

Area	Address	Area Code	Phone Number	Fax Number
Atlantic	Regional Superintendent Air Carriers Operations Transport Canada P.O. Box 42 Moncton, New Brunswick, E1C 8K6	506	851-7249	851-7190
Beaufort Sea	Regional Superintendent Air Carriers Operations Transport Canada Suite 1100, Canada Place 9700 Jasper Avenue Edmonton, Alberta, T5J 4E6	403	495-3868	495-4622
Eastern Hudson Bay	Regional Superintendent Air Carriers Operations Transport Canada Suite 300, 4900 Yonge Street Willowdale, Ontario, M2N 6A5	416	224-3765	224-4711
Western Hudson Bay	Regional Superintendent Air Carriers Operations Transport Canada P. O. Box 8550 333 Main Street Winnipeg, Manitoba, R3C 0P6	204	983-1409	983-1734

Area	Address	Area Code	Phone Number	Fax Number
Québec	Regional Director Air Carriers Operation (NAX) Transport Canada 700 rue Leigh Capreol Dorval, Quebec, H4Y 1G7	514	633-2836	633-3697

Industry Contacts

Area	Address	Area Code	Phone Number	Fax Number
Canada	Canadian Association of Petroleum Producers (CAPP) 2100, 350 - 7 Avenue SW Calgary, AB, T2P 3N9	403	267-1100	261-4622
Nova Scotia	Canadian Association of Petroleum Producers (CAPP) Suite 230, 1801 Hollis Street Halifax, NS, B3J 3N4	902	420-9084	491-2980
Newfound land and Labrador	Canadian Association of Petroleum Producers (CAPP) 235 Water Street, Suite 905 St. John's, NL, A1C 1B6	709	724-4200	724-4225

Regulator Contacts

Area	Address	Area Code	Phone Number	Fax Number
Canada	National Energy Board 444 Seventh Avenue SW Calgary, AB, T2P 0X8	403	292-4800	292-5503
Nova Scotia	Canada-Nova Scotia Offshore Petroleum Board (CNSOPB) 1791 Barrington Street Halifax, NS, B3J 3K9	902	422-5588	422-1799
New-foundland & Labrador	Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) 140 Water Street St. John's, NL, A1C 6H6	709	778-1400	778-1473