Guidelines Respecting Physical Environmental

Programs during Petroleum Drilling and

Production Activites on Frontier Lands

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ABBREVIATIONS AND DEFINITIONS

AES - Atmospheric Environment Service
BIO - Bedford Institute of Oceanography
CATA - Canadian Air Transport Administration
CNOPB - Canada-Newfoundland Offshore Petroleum Board
CNSOPB - Canada-Nova Scotia Offshore Petroleum Board
DOC - Department of Communications
IOS - Institute of Ocean Sciences
MANMAR - Manual of Marine Weather Observing (AES manual)
MEDS - Marine Environmental Data Service
NEB - National Energy Board
NWS - National Weather Service - U.S.
SAWRS - Supplementary Aviation Weather Observations (AES manual)
SOR - Statutory Orders and Regulations
WMO - World Meteorological Organization

Qualified Meteorologist - A qualified meteorologist may be any graduate of a specified program in meteorological studies at a recognized university and/or anyone having completed a course of studies prescribed by a major national weather service such as the AES in Canada or the NWS of the USA. Understanding of local weather features and patterns is highly desirable.

Data Storage Media - End of Well Environmental data may be submitted to the Regulator on 9-track magnetic tape or floppy diskettes. The floppy diskettes should be MS-DOS, IBM-PC compatible. Floppy diskettes may be in either 5¼ inch 360 kbyte or 1.2 Mbyte, or 3½ inch 720 kbyte or 1.44 Mbyte capacity. Floppy diskettes or 9-track tape are hence forth called acceptable data storage media. The format of the data should be GF-3 or as otherwise specified in these Guidelines and if the data are compressed, the operator should provide the decompression utility with the data.

Ice-Hazard - any ice feature (floe, ridge, keel, etc.) or ice condition (pressured ice) that could potentially create or exceed conditions defined as hazardous within the operator's environmental alert manual for the particular exploration, development or production installation in consideration.

Data Units - The raw data should be converted from internal instrument units to SI units but should not be edited in any way. Directions should be converted to degrees true, and all times should be reported in Coordinated Universal Time (UTC). Current components should be reported in U (East positive), V (True North positive), and W (Up positive). Reference Geodetic Datum should be provided when reporting latitude and longitude.

1.0 INTRODUCTION

These Guidelines are intended to clarify requirements for the operators of petroleum drilling or production installations concerning the observing, forecasting, and reporting of

physical environmental data which appear in the following federal, Nova Scotia, and Newfoundland Frontier Lands Regulations:

- Canada Oil and Gas Drilling Regulations;
- Canada Oil and Gas Production and Conservation Regulations;
- Nova Scotia Offshore Area Petroleum Drilling Regulations;
- Nova Scotia Offshore Petroleum Production and Conservation Regulations (draft);
- Newfoundland Offshore Petroleum Drilling Regulations;
- Newfoundland Offshore Petroleum Production and Conservation Regulations (draft); and
- Transport Canada Air Regulations and Aeronautics Act and accompanying Air Navigation Orders.

The primary objective of the physical environmental monitoring programs described in the Guidelines is to ensure that appropriate weather, oceanographic, and ice information is available during an exploratory drilling or production program to support the safe and prudent conduct of operations, emergency response, and spill counter-measures. Information collected during the program is also necessary to establish a sound and reliable data base, which in turn assist operators in planning future operations in the area, and the Regulators in performing its duties relating to environmental assessment, review of design and operating criteria, and review and approval of applications and contingency plans.

A description of the weather, oceanographic, and ice programs, where appropriate, must be submitted either to the National Energy Board (NEB), to the Canada-Newfoundland Offshore Petroleum Board (CNOPB) 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 description should accompany the application for Drilling Program Authorization, in the case of exploratory drilling, and the application for Production Operations Authorization in the case of production. Any changes to these programs, associated with a change in offshore installation or location, should be noted in the drilling or production application. The operators are encouraged to consult with the Regulator about the program as soon as possible, where such changes are contemplated.

The description should include, at least, the following information:

1. The instrumentation proposed for use, including the make, the model number, and location of spares for each instrument;
2. The mounting locations, the method of mounting, and the exposure of each instrument;
3. The calibration and maintenance schedule for each instrument;
4. The names, addresses, and description of the roles of any contractors involved in the program;
5. A description of any unusual or non-standard features of the program.

Previous versions of these Guidelines 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 Guidelines which may be suggested by these developments. The present edition was developed through a consultative process including representation from industry, government departments, Canadian Environmental Committee on Petroleum Activities, and consultants as well as International Ice Patrol and U.S. Mineral Management Service. Ongoing consultation is encouraged by the Regulator.

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2.0 PHYSICAL OCEANOGRAPHIC GUIDELINES

A. PHYSICAL OCEANOGRAPHIC PROGRAM

Operators should gather and report oceanographic data in accordance with these Guidelines unless the Regulator has agreed, IN WRITING, to other arrangements.

i) Instrumentation

A variety of instruments and techniques may be used to satisfy the objectives of these Guidelines. 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 Guidelines do not specify the types of instrumentation which 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. Operators considering 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.

A description of the proposed instrumentation and its deployment configuration, which includes at minimum the items described in Section 1.0, should accompany the operator's proposal. Depending upon the nature of the proposed instrumentation, inclusion of the following also may be appropriate:

1. A description of instrument data sampling, processing, and storage/transmission features;
2. Calibration test results;
3. A description of oceanic characteristics in the intended region of operation which could influence the operation of the instrumentation or the validity of its measurements;

and
4. For new technology instrumentation, an explanation of the principles, algorithms, and methodologies underlying its operation, including validation or extrapolation techniques as appropriate.

New technology instrumentation may be capable of obtaining much more information than is possible using conventional instruments. Operators using this instrumentation therefore are encouraged to acquire and archive data at more frequent depth and time intervals. Diagnostic data also should be archived to permit the evaluation of data quality and integrity.

Supplementary guidance for operators considering the use of Acoustic Doppler Current Profilers (ADCP) in place of conventional instrumentation is provided in Appendix 3 (hard copy only). ADCP data submissions should be in GF-3 format (MEDS, draft 1993)

ii) Standards

The results of the measurement programs are of most use when the data which 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 Guidelines should be incorporated in the design of the operator's program.

The minimum specifications are described in Table I, Section 2.0(A) and relate to most areas, however due to the variability of environmental conditions**,** some drilling or production sites may dictate use of different specifications. Operators therefore are encouraged to choose the sensor ranges in consideration of anticipated conditions.

iii) Pooling of Resources

Operators in a particular area are encouraged to pool their resources and to consult with the appropriate government agencies (Table II, Section 5.0) with a view to conducting combined measurement programs. In all cases, to ensure appropriate flow of communications, the initial contact should be with the Regulator.

iv) Parameters to be Observed or Measured

An oceanographic measurement program should be designed to meet the objectives listed above. In most instances the following programs will suffice.

Table I

SPECIFICATIONS FOR OCEANOGRAPHIC MEASUREMENTS

Parameter	Range	Accuracy	Resolution
Current Direction	0 - 360°	$\pm 5^{o}$	1.0^{o}

Current Speed	0.05 - 2.50 m/s	± 0.02 m/s	0.001 m/s
Water Temperature	-2 to 25°C	0.05°C	0.02°C
Salinity (Conductivity)	0 - 36%	±0.1%	0.01%
Tides (Pressure)	0 - 20 m	± 0.01 m	0.001 m
Wave height	0 - 30 m	±3% for periods between 2 and 20 sec. ±6% for periods between 20 and 30 sec.	
Wave period	0 to 40 s	± 1 s	0.2 s

a) Moored Current Measurements:

The currents time-series should be measured, as a minimum, at three levels in the water column viz. near-surface in the anticipated wave zone, mid-depth, and near-bottom near each offshore installation. The vertical spacing between the three depths will depend upon the water depth and water mass characteristics at the particular site. The current measurements at mid-depth and near-bottom should be dynamically de-coupled from the anticipated surface waves.

All current measurements should include pressure, temperature, and conductivity as well as velocity. Pressure, temperature, and salinity data provide information on identification of water masses and complement water movement data provided by the velocity measurements. Temperature and salinity should be measured on a regular basis as agreed to in consultation with the Regulator. Specifications for the measurements are given in Table I, Section 2.0(A). All current meters should have a sampling interval no longer than one-half hour and if possible the meters should start sampling "on the hour".

Moorings or deployments should be maintained in one location for as long as possible and need not be moved with every relocation of the offshore 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 must be approved by the Regulator prior to deployment.

The data should be reported in a Current Meter Data Report, the format of which is prescribed in Section 2.0(B)(v).

b) Real Time Current Profiles:

In anticipation of operational requirements for drilling, diving support, iceberg, oil spill trajectory prediction, emergency response, contingency plans, or for other reasons, the operator must satisfy the Regulator that he has the ability to make real time current measurements, including profiling measurements, as required. The methods approved will depend upon the area of operation, depth of water, geometry of the drilling unit, and the purposes for which the measurements might be needed.

If systematic measurements are made, the data should be reported in a format to be determined on a case-by-case basis by the Regulator. The Regulator may request that this equipment be tested or inspected from time to time to ensure that it would be available for emergency use.

c) Tidal Elevations:

Tide measurements may be required at some locations. All tidal measurements should be made to the specifications set down by the Canadian Hydrographic service (Forrester, 1983) and in Table I. Pressure-activated tide gauges may be placed either in the current meter moorings, on their own separate moorings, or on the blowout preventer stack if suitably insulated from vibration. A recording interval of no more than one hour is required, and instruments should be started "on the hour".

The instrument data tape should be provided to the Regulator, for archival and constituent analysis. Provision of the instrument data tape and the Instrument Log Sheet (Section 2.0(E)) to the Regulator will fulfil all reporting requirements although operators are encouraged to perform their own analyses. The period of measurement should be shown on the bar chart in the Current Meter Data Report.

v) Recording of Data

Data collected by current meters and tide gauges should be recorded in a computer-compatible method. All instruments should be calibrated prior to and after deployment or at regular intervals as approved by the Regulator, and the details of the calibration are to be provided to the Regulator either in the Data Report or separately.

B. PHYSICAL OCEANOGRAPHIC DATA REPORTS

Data reports serve two functions: to present the data collected in a summary fashion that is usable without processing; and to allow the raw data to be archived in a meaningful fashion by documenting mooring details, analysis procedures, and instrument calibrations.

i) Types of Reports

As part of the Final Well History Report, two oceanographic data reports are usually required from each offshore installation, although they may be submitted within the same covers. The first should contain a documentation and summary of all oceanographic measurements, with the exception of the wave data, made by the operator. The second should contain the wave data. In all cases, the object of these reports is to report data. It is neither necessary, nor desirable, to mix speculations about the meaning of the data in with the actual data. The data report should contain a hard copy record of all details of calibration and deployment that are recorded on the tape header, and any additional data that the operator thinks would be useful in the quality control and analysis of the data. Operators are not encouraged to provide lengthy, printed listings of data.

All data reports should be signed with the name of the individual who was responsible for its production and who is able to answer specific questions about the data contained in the report.

ii) Oceanographic Data Storage Media

All data collected in the oceanographic program, with the exception of tidal data, should be submitted to the Regulator on acceptable data storage media and in a format suitable for archiving at MEDS and either BIO or IOS. These submissions should be written in GF-3 format (MEDS, 1985b), which has been adopted by the Intergovernmental Oceanographic Commission (IOC) for the international exchange of oceanographic data. Information on this format, some computer programs for handling it, and training are available from MEDS.

Each data storage medium should contain both the raw, unedited data and also the edited, filtered, hourly data used in the construction of the data report.

The GF-3 header block should contain the following information, in ASCII format:

a) Deployment details:

- Latitude, longitude, and Reference Geodetic Datum;
- Water depth;
- Instrument manufacturer, model number, and serial number;
- Calibration details;

- Instrument configuration information;
- Date and time of instrument deployment and recovery; and
- Personnel responsible.

b) Duration for which data are provided; and

c) Cross-reference to accompanying reports including:

- Report number (where applicable);
- Operator and contact person (name, address, phone number); and
- Report author and/or contractor (name, address, phone number).

iii) <u>Archiving of data</u>

Data storage media and reports will be archived at MEDS. Data collected on the East Coast and the Eastern Arctic will also be archived with BIO, while data collected on the West Coast and the Western Arctic will also be archived with IOS. Data reports, but not magnetic tapes or floppy diskettes, will be archived by the Regulator.

Operators should either archive the original instrument tapes at BIO, IOS, or MEDS or provide clear descriptions of their own archival facilities and submit an acceptable plan to ensure the proper archiving and retrieval of the instrument tapes.

iv) <u>Submission of Data and Reports</u>

Operators must submit, to the Regulator, four copies of each of their Oceanographic and Wave Data Reports and one copy of the associated GF-3 data storage media within 90 days of the rig release date in the case of exploratory drilling programs, or annually (on a calendar year basis) in the case of production programs.

v) <u>Current Meter Data Report Format</u>

The current meter report format is designed so that all information useful for archiving the raw data is collected in one place and that an overview of the data collected may be obtained without further processing. It should, therefore, be in four sections: an archival section, a data plot section, an analysis section, and a statistical summary section. The object, in all cases, is to present the information in as concise a form as possible, with a minimal amount of text.

To aid in comparing reports, standards of presentation have been set and should be adhered to, except when prior agreement has been made with the Regulator.

Note that time must be reported in Coordinated Universal Time (UTC) and that SI units must be used throughout the report.

a) <u>Archival Section</u>:

1) Location Diagram - The location diagram should be a chart or map of the general area showing the bathymetry and the location of all moorings whose data are presented in the report. It should be at such a scale that some identifiable land mass or bottom relief is contained on the diagram, as well as appropriate latitude and longitude graticules.

2) Bar Chart - The bar chart should show the periods of data return from all instruments whose data are presented in the report. In the case of mobile offshore installation, it also should show the length of time that the offshore installation was on site. Periods of data return for the wave recorder, other oceanographic measurements, and the meteorological program should also be included where possible. Current meters should be identified both by instrument number and depth.

3) Mooring or Deployment Diagrams - A diagram of all moorings or deployment should be included, not necessarily to scale, showing the configuration of the mooring including: anchoring systems; the size, material, and length of line used; the location, material, and size of shackles, swivels, buoyancy packages, acoustic releases, and instrument configurations; and the make and location of the subsurface floats and marker buoys.

4) Instrument Log Sheets/Calibration Curves - One instrument log sheet should be included for each current meter or tide gauge deployed. A copy of the instrument log sheet to be used is attached in Section E.

An up-to-date set of calibration data and curves should be supplied for each instrument deployed, or specific reference should be made to a calibration program submitted separately to the Regulator. The calibration data should be included with the data on acceptable storage media in the GF-3 format.

5) Deployment/Recovery Logs - Photocopies of the original deployment and recovery log sheets, used by the officer-in-charge of operations in the field should be provided for each mooring. These should be photocopies of the originals and not be re-typed versions. There is no prescribed format for these and each operator may use whatever form suits his own purpose best, although it

should be noted that most current meter manufacturers will provide forms designed to be used with their instruments.

6) Description of Edit Procedures - This should be a concise description of the editing, filtering, and data processing procedures used on the recorded data and the actual calibration equations used to convert internal, instrument values into SI units. It should include a description of the algorithms used for the editing and filtering procedures.

In the case of those operators/consultants who submit reports on a regular basis, this section should remain constant from report to report. The use of automatic, computer-based editing is encouraged, but in any case, editing standards should be objectively based and this section should include a description of the basis for editing.

The conversion of temperature, pressure and conductivity to salinity is to be done using the Practical Salinity Scale (UNESCO, 1981). In this document, salinity will be considered to be the measured parameter, rather than conductivity.

7) Unusual Occurrences - This section is normally expected to be very short and should confine itself, as much as possible, to fact rather than speculation. It should include a complete description of unusual edit procedures and an explanation of data gaps and of all data recovery techniques used in the report which are not already described in Section 6 above.

An assessment of data quality and a description of any unusual occurrences should be provided. This section should include a brief description of what is being done to correct any problems with data return that have been noted above.

b) <u>Data Plot Section</u>:

1) Time-Series Plot of Raw Data - Each 15 or 16 days of raw data should be plotted at a time scale of 12 mm/day. Plots should start on the 1st or 16th of each month. Plots of pressure, temperature, salinity, speed, direction, U (East positive) and V (TRUE North positive) are required. The raw data should be converted from internal, instrument units to SI units but should not be edited in any way. The vertical scale for each parameter should be consistent throughout any given data report. Direction should be converted to degrees True, and all times should be reported in Coordinated Universal Time (UTC). Each 15 days of data measured by one

instrument should be plotted on no more than two adjacent pages. All necessary scales should be clearly labelled, and the instrument number and depth shown on each page.

2) Time-Series Plots of Hourly, Edited Data - The raw data time-series should be edited, filtered to remove frequencies higher than 0.5 cycles/hr, and then sub-sampled at one-hour intervals. The results of this process should be plotted using the same scales and plot routines as for the raw data.

3) Speed and Direction Joint Frequency Distributions - The hourly, filtered speed and direction data should be plotted on either joint frequency diagrams, using the procedure in Forrester (1982) or in speed and direction histograms, whichever is the most useful to the operator.

c) Analysis Section

The analysis section should provide a brief description of the data collected. Since oceanographic conditions are variable from region to region and since different operators may have different requirements for the data, there is no specified format or list of analyses which is required for each data report. Operators are encouraged to submit all analyses of the data which they have done for their own use.

Some of the following types of analyses may be considered to be appropriate:

1) low-pass filtering and plotting of the edited data,
2) progressive vector diagrams,
3) stick plots of the hourly data and the low-pass filtered data,
4) tidal constituent analysis of current meter and tide gauge data,
5) spectral analysis of the residual data (observed data minus predicted tidal components),
6) persistence diagrams,
7) exceedance diagrams.

d) Statistical Summary Section

A one-page summary is required providing the statistics of each of the edited parameters measured, for the whole period of record, at each instrument. This should include the maximum, minimum, mean, and standard deviation of each parameter, as well as the co-variance of U and V. In the case of current velocity, statistics for speed, U, and V are required.

C. WAVE MEASUREMENT PROGRAM

The specifications contained here for the measurement and reporting of surface wave data should be considered minimum requirements. Operators wishing to operate more sophisticated or comprehensive measurement programs (especially directional wave measurements) are encouraged to do so. MEDS will make available any applicable software it has as an aid in developing and implementing the necessary data reduction and analysis systems.

i) Instrumentation

The wave-sensing device should be an instrument designed for the accurate measurement of the spectra of wind waves. Specifications are given in Table I.

Broad-band noise on the sensor/recording system should contribute not more than 0.05 m to the significant wave height obtained by integrating between wave periods of 2 and 30 seconds. Narrow-band noise should contribute not more than 0.01 m to the RMS value of the signal in any one-second period band between 2 and 30 seconds.

All wave measuring devices that have transmitting devices must be approved and licensed by DOC. Each time such a measuring device is installed or removed, the regional offices of the DOC must be notified.

Operators are advised to check that their proposed wave measurement instruments are acceptable to the Regulator. If instruments unfamiliar to the Regulator are proposed, companies may be required to submit at-sea validation data for the first deployment of a new instrument, demonstrating that the instrument meets the required specifications. MEDS will aid in providing an appropriate comparison buoy and the necessary data processing for the inter-comparison if requested well in advance. As stated in Section 2.0(A)(i), these Guidelines do not specify what instrumentation should be used for wave measurement program. The operator should provide all the information cited in Section 1.0 and 2.0(A)(i) in order for the Regulator to ascertain the merits of the proposed instrumentation and make a decision on its suitability to the particular exploration or development application.

Supplementary guidance for operators considering the use of Marine Wave Radar systems in place of conventional instrumentation is provided in Appendix 3 (hard copy only).

ii) Location

The wave measuring instrument should be located so that the wave field being measured is not disturbed by the offshore 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.

Moorings or deployments should be maintained in one location for as long as possible and need not be moved with every relocation of the offshore installation in a particular area. Consideration should be given to mooring or deployment longevity rather than relocation, whenever possible. Operators, in a particular area are encouraged to pool their resources and to consult with the appropriate government agencies (Table II , Section 5.0) with a view to conducting combined measurement programs.

iii) Recording Interval

The recording periods should be between 17.5 and 35 minutes in length and should occur at least once every 3 hours.

When the significant wave height exceeds 4 m or the wind speed is greater than 17.5 m/s (34 knots), continuous recordings of the wave height should be made. Continuous recording should consist of successive records of duration equal to those made in the normal recording scheme. The individual records should be analyzed as such, rather than as one very long, continuous record.

iv) Calibration

All instruments should be calibrated before and after all deployments and in accordance with the manufacturer's specifications.

Calibrations should be performed at least at periods of 3, 5, 12, 20 and 27 seconds. Calibration data used in correcting the raw data should be supplied as part of the wave data reports.

If the observed wave height is beyond the calibration/validation range of the instrumentation, a detailed description on how the extrapolation was achieved should be provided with the wave data report.

v) Analysis Procedure

Data should be spectrally analyzed by either the Fourier transform or MEM methods, as described in Wilson and Baird (1981) or Godin (1982).Operators using non-conventional instrumentation should provide the various algorithms and methodologies used in obtaining the final results.

D. WAVE DATA REPORT

i) Wave Data Format

One copy of the wave data on acceptable data storage media should be submitted to the Regulator in the GF-3 format (MEDS, 1985a). Format information is available from MEDS on the standard subsets for one dimensional and directional wave spectra and surface elevation time series. The data which are provided should include both the wave spectra and the surface elevation time series and one dimensional and directional spectra if an instrument which measures two-dimensional spectra is used. MEDS can supply a certain amount of software to assist in developing computer systems to write the necessary GF-3 subsets.

ii) Wave Data Report Format

The purpose of the wave data report is to provide both archival data and an overview of the data collected. Four copies of the wave data report should be submitted to the Regulator, as appropriate. The report should contain the following products:

a) Archival Information:

This section should list the instrument make, model, and serial number, transmission frequency, position, the water depth at the site of the measurement, a mooring diagram (if applicable), and the beginning and end dates for the data contained in the report.

b) Calibration Data:

This section should contain the latest calibration data for the wave measurement instrument being used. This calibration data should not be more than six months old and conform with the requirements stated in Section 2.0(C)(iv).

c) Data Quality Report:

This section should indicate the percent success rate of the data, defined as the percent data return multiplied by the percent of the data returned which is usable in calculating wave spectra. The section should describe problems or difficulties encountered during the period covered by the report. Data gaps or any difficulties which affect the quality of the data should be explained.

d) Data Plot Section:

This section should contain the following four diagrams:

1) A plot of significant wave height and peak period of the spectrum vs. time. The time scale should be 12 mm/day and each plot should begin either on the first or sixteenth day of the month.

2) A plot or table presenting the percentage exceedance of wave height for each month of data during the period covered by the report.

3) A plot or table presenting the histogram of the distribution of peak periods for each month of data for the period covered by the report.

4) A plot or table presenting the joint distribution of peak periods and wave heights, for each month of data.

If instrumentation is used which is capable of obtaining comprehensive information on the wave regime at the drilling or production location, the Regulator encourages collection of this enhanced data set. The operators should provide one dimensional spectrum in spectral density by frequency and two dimensional spectrum in wave number in addition to the above four plots. These latter plots should be on acceptable data storage media identified earlier and collected at intervals stated in Section 2.0(C)(iii) above.

E. INSTRUMENT LOG SHEET

Well Name:	Operator:
Consultant:	
Address:	
Officer-in-Charge:	
Navigation System:	Longitude:
Latitude:	Inst. Depth:
Water Depth:	Model No./Serial No.:
Instrument Make:	Recovery Date:
Deployment Date:	Inst. Stop Date/Time:

Inst. Start Date/Time:	Time out of water:
Time in water:	Time off bottom:
Time on bottom:	Averaging Interval:
Sampling Interval:	No. Samples Recorded:
No. Samples Expected:	Data Tape Identifier:
Magnetic Variation:	
No. of Active Channels:	
Calibration Dates:	

(attach calibration reports)

COMMENTS: All depths are in m and times in UTC.

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3.0 METEOROLOGICAL GUIDELINES

A. METEOROLOGICAL OBSERVATION PROGRAM

Operators are required, pursuant to Drilling, and Production and Conservation Regulations, to take meteorological and ice measurements during exploratory drilling and production programs on Frontier Lands. Unless otherwise agreed to IN WRITING by the Regulator, meteorological observations are to be taken in accordance with the procedures outlined in the MANMAR and SAWRS manuals. Periodically, these manuals will be updated or amended by AES. The Regulator, after consultation with operators and AES, may exempt operators from those standards and procedures deemed not to be applicable to offshore operations. Supplementary instructions for MANMAR (COGLA 1990a) and SAWRS (COGLA 1990b) provide details on application of standards to Frontier Lands.

i) Methods of Measurement

The measurement of meteorological parameters requires the use of instruments which meet or exceed the standards set by the WMO and/or AES. Instruments must be capable of measuring the extremes of a particular parameter in the area of operation. For a detailed description of instrument specifications, contact the National Director General, Weather Services Directorate, AES Headquarters (Table III, Section 5.0).

All offshore installations should be equipped with wind instrumentation that will provide automatic computer-averaged read-outs using a ten-minute interval for MANMAR synoptic observations and a two-minute averaging interval for SAWRS hourly observations.

ii) Parameters to be Observed or Measured

The following is a list of the parameters to be observed or measured:

- Wind Speed and Direction
- Barometric Pressure
- Air Temperature
- Dew Point
- Sea Surface Temperature
- Sky Condition
- Present and Past Weather
- Visibility
- Ice Accretion
- Sea State
- Sea Ice/Icebergs/Ice Islands
- Precipitation - Liquid precipitation measurements may be required for selected offshore installation.

iii) Frequency of Observations

The above standard meteorological parameters should be coded in MANMAR format and transmitted to AES for domestic and international distribution every 3 hours. Hourly and special meteorological observations in support of aviation operations in accordance with the SAWRS manuals are required at most sites. These reports should also be transmitted to AES for distribution. Operators are encouraged, however, to record and transmit hourly observations at all times. When the significant wave height exceeds 4 m and/or the 10 minute average wind speed exceeds 17.5 m/s (34 knots), wind and wave parameters should be monitored as continuously as possible. These figures may be reduced to reflect operational requirements.

Synoptic marine observations provided according to the MANMAR Manual should adhere to the provisions under sections 4.7 and 4.8 of MANMAR Amendment No. 2. Furthermore, specifications under sections 4.7.1 and 4.8.1 of the amendment should be applied in the following manner:

> **a)** During that period of the day when regular hourly SAWRS reports are being provided by offshore installation observers, special supplementary MANMAR reports, using

the Special Weather Report (SPREP) and Storm Report (STORM) headers, will not be issued by the observers. The observer should be instructed, however, to add the SPREP and STORM headers to the first regular MANMAR report immediately following the occurrence of the criteria specified under sections 4.7.1 and 4.8.1 of the Amendment, providing that the criteria are still occurring at the time of the regular report.

b) During the period when regular hourly SAWRS reports are not being taken and transmitted at the offshore installation, the observer should issue special SPREP and STORM reports in accordance to sections 4.7.1 and 4.8.1 of the Amendment.

c) For the purpose of determining criteria under sections 1.8.4.2 and 1.8.5.1 of MANMAR for the issuance of the SPREP and STORM reports, the observers should use the gale and storm warnings provided to the operator by the contractor for site-specific forecast services.

Additional amendment notifications will be included in this document when determined by AES and approved by the Regulator.

iv) <u>Installation, Maintenance, and Inspection of Instrumentation</u>

Officials of AES (Table III) responsible for the area of operation should be consulted on the installation of equipment in order to ensure optimum positioning of the instruments on the offshore installation.

Procurement, installation, and maintenance of the equipment are the responsibility of the operator. Technical questions relating to instruments should be directed to the Regional Director of the appropriate AES Region (see Table III, Section 5.0). The operator should have the meteorological instrumentation on each offshore installation inspected by an AES Port Meteorological Officer or other designated official for the appropriate region before the unit commences its drilling or production program and periodically during the program. Inspection trips by AES will be coordinated through the Regulator.

The observing programs aboard the offshore installation will be monitored by the Regulator.

v) <u>Training</u>

The observers taking meteorological and ice observations on the offshore installation must have successfully completed approved training dealing with the procedures for observing, recording, and reporting weather and ice parameters. All offshore observers must be qualified to take both marine and aviation observations in accordance with the appropriate MANMAR and/or SAWRS manuals and be currently certified by AES to take SAWRS observations. Observers must also be familiar with the contents of the MODU Supplementary Instructions/MANMAR (COGLA 1990a) and the MODU Supplementary Instructions/SAWRS (COGLA 1990b).

Personnel who have been certified by AES to take SAWRS observations, are qualified to observe and record only. This training is considered minimal and does not qualify the observers to interpret meteorological forecasts and/or weather charts.

In areas where drilling or production operations may be affected by pack ice, icebergs, or ice islands, observers should have technical competency in ice monitoring including:

- ice detection and monitoring equipment
- ice coding and tracking techniques
- ice plotting techniques
- iceberg dimension measuring techniquesl; and
- interpretation of remote sensing imagery

Observers should also be familiar with ice management practices and techniques in the area of operation.

All efforts should be made to ensure that an experienced observer is present on each offshore installation at all times, particularly in areas when ice monitoring or management activities are required.

vi) Recording of Observations

Meteorological observations should be recorded in the appropriate log book or computer data base in accordance with the procedures outlined in MANMAR and SAWRS manuals. These log books and manuals are available from the Regional Director, AES.

When completed, the log books or computer data base printouts should be submitted to the Regional Director in the respective AES region. All meteorological observations will be quality controlled and archived at AES headquarters in Downsview, Ontario.

B. METEOROLOGICAL SUMMARY REPORT

As part of the Final Well Report, operators should provide reports on weather and ice conditions and should prepare and submit to the Regulator, as appropriate, data in acceptable data storage media in accordance with specifications outlined in Appendix 1A (hard copy only).

Operators should have all observed parameters placed on acceptable data storage media and should prepare reports in accordance with i) below.

Operators should submit to the Regulator, as appropriate, four copies of their Meteorological Summary reports and one copy of the associated data in acceptable data storage media within 90 days of the termination of an exploratory well. For development programs, reports and data sets are to be supplied to the Regulator annually, on a calendar year basis, by 31 March of the succeeding year.

i) Meteorological Summary Report Format

The report should include:

a) acceptable data storage media documentation Appendix 1A (hard copy only);

b) a table of monthly extremes (maxima and/or minima) of all weather parameters observed or measured;

c) a summary of weather and/or ice related;

- production and/or drilling down time
- time when offshore installation is off site

d) an evaluation of data quality, instrumentation, data gaps, etc.;

e) a description of any modifications made to the original measurement or recording plans;

f) summary of all ice conditions and management activities; and

g) recommendations for change in any future measurement program.

C. METEOROLOGICAL FORECAST SERVICES

Two types of weather forecast services are normally required: site-specific forecast services for normal and emergency conditions related to drilling or production operations; and aviation weather forecast services for support flights.

i) Site-Specific Forecast Services

The operators must arrange for site-specific weather and sea state forecasts in support of their operations. These should meet the needs of both normal and emergency operations and should be at least equivalent in quality and accuracy to forecast services provided by the AES.

The forecast should be consistent with AES core forecast guidance for the area and should be prepared by qualified meteorologists familiar with AES guidance, practices, and procedures. Emphasis in these site-specific forecasts should be on increased spatial and temporal detail.

If a major departure from the AES regional forecast appears warranted, the forecaster preparing the site-specific service should consult with the appropriate AES Weather Centre. Any AES Weather Warning in effect for the drilling areas must be mentioned.

Consultants providing forecast services should be 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:

a) forecast issuance at least every 12 hours, with a six-hour mandatory update or more frequently as required. A continuous weather watch must be maintained by a qualified meteorologist;

b) forecast for each synoptic hour in the forecast period of wind speed and direction, sea state (wave height, period, and direction), precipitation, visibility, sky conditions, air temperature, freezing spray and icing conditions (when appropriate); and a synopsis of present weather patterns.

c) forecasts should extend over a 48-hour period;

d) an outlook covering the period 48 to 120 hours should be included and should be more qualitative in content;

e) in the case of an emergency, special forecasts tailored to the emergency should be prepared and updated as required;

f) at least half of the contractor's forecast team should have substantial experience with AES core guidance material;

g) the forecast team should have professional forecast experience in the geographical region;

h) an effective data communications system is required to ensure the timely transmission and receipt of environmental data and forecasts.

In order for forecasts to be of acceptable quality and accuracy, the addition of observation stations to the existing network may be necessary. The Regulator, in consultation with AES, will provide guidance concerning deployment of additional stations.

ii) Aviation Weather Forecast Services

Transport Canada, CATA, requires that area aviation weather forecasts (FA) be available to support aviation services to offshore installations or remote shore bases. These forecasts are provided by AES. At the present time, CATA has no requirement for aviation aerodrome forecasts (FTs) for offshore installation**s**. However, if the operator has a requirement for FTs, arrangements should be made through the regional CATA office (Table III, Section 5.0).

In support of the FA program, aviation observations in accordance with SAWRS standards are required.

Current observations of altimeter setting in addition to wind speed and direction to SAWRS standards, for relay to pilots on approach to installation, will be required for instrument approach to the lowest descent altitude.

The operator should operate an aviation observing program from two hours prior to a flight to or from the identified offshore installation (or remote location) until the time that the flight terminates and make such observations immediately available to AES networks. Alternately, the operator may provide the aviation program continuously or from 0600 to 2100 Local Standard (or Daylight) Time each day to minimize the number of requests to manage such a program.

D. FORECAST VERIFICATION REPORT

As part of the Final Well Report operators should submit to the Regulator, two copies of a Forecast Verification Report. The report should present a verification of the weather and sea state forecasts and a description of the forecast services provided in Appendix 1B (hard copy only). In order to maintain consistency in verification, the following should be included in the report:

- forecast parameters to be verified, including wind speed, wind direction, and wave height;
- time series of comparisons of forecast and observed values for each 12, 24, 36 and 48 hour lead times. 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;
- contingency tables of forecast and observed values for each of 12, 24, 36, and 48 hour lead times;
- quantitative statistics calculated including BIAS, MAE, RMSE;

- categorical analysis statistics including contingency table summaries, Percent Correct, Post Agreement, and Prefigurance;
- for Extreme Event analysis verification, POD (Probability of Detection), FAR (False Alarm Ratio) and FAR1 (False Alarm Rate) should be calculated. For the purposes of extreme event verification, the Maximum Wind Speed shall be the single highest sustained wind speed recorded on the MANMAR reports for the site during the period T-3 to T+3. Similarly the maximum wave height shall be the maximum wave height calculated from the highest single significant wave height recorded on the MANMAR reports for the site during the period T-3 to T+3. Alternatively, maximum wave heights derived for that period from the approved wave measuring instrument record at the site may be used for verification; and
- verification statistics calculated on a monthly basis as described in Appendix 1B (hard copy only). To obtain meaningful results, the extreme event statistics, POD, FAR and FAR1, should be calculated on the basis of a reasonable time frame that will provide a sufficient number of events (about 10). 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.

4.0 ICE MANAGEMENT GUIDELINES

A. ICE MANAGEMENT PROGRAM

When operations are conducted in pack ice or areas of drifting icebergs or ice islands, an ice management plan will be implemented by the operator under the Contingency Planning Guidelines to ensure the safety of drilling or production operations. Since ice conditions can vary greatly from area to area, and season to season or year to year within an area, ice management plan should be tailored to the region, period, and nature of the operation. The plan should include systems for ice detection, surveillance, data reporting, collation, quality control and presentation and, where applicable, a local tactical ice forecasting component.

Iceberg/ice island and ice-hazard(1) trajectory forecast service should reflect the operator's contingency plan specifications.

1. See definition in Abbreviations and Definitions section.

The frequency of ice-hazard[1]/iceberg forecasts should be commensurate with the level of threat as determined from the operator's Ice Alert Procedures. The operator should also arrange for regular verification of the ice-hazard[1]/iceberg forecasts. In any case the verification methodology should be submitted to the Regulator for approval.

B. ICE REPORT

Under the ice management plan, additional information above and beyond that collected under MANMAR is available. To satisfy the Regulator's safety and operational audit, East Coast Operators will report the following iceberg and/or sea ice information once daily (when applicable) to the Regulator:

- icebergs: time of observation, geographic position (latitude & longitude), type, source of observation, and area surveyed; and
- sea ice: ice boundary, type, concentration, and area surveyed.

Operators are expected to maintain separate logs for ice and/or ice-hazard[1]/iceberg data. Special reports will be made to the Regulator when dictated by significant events.

C. ADDITIONAL ICE DATA

A summary of ice information (4 copies), including any ice forecast verification statistics, will be submitted to the Regulator (as appropriate) in a separate self-contained document as part of the Final Well Report. Data in acceptable data storage media (1 copy) accompanying the summary should be coded in the format provided in Appendix 1B (hard copy only).

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5.0 REFERENCES

CATA, 1985, Transport Canada Air Regulations and Aeronautics Act, Part 5, Rules of the Air, Divisions 3 and 4 concerning requirements for Aviation Weather Support. TP 524 E; and Air Navigation Orders,. TP 718E.

COGLA, 1980, Canada Oil and Gas Drilling Regulations, Ottawa, 35 pp.

COGLA and CNOPB, 1986, Drilling for Oil and Gas on Frontier Lands, Guidelines and Procedures, Ottawa. September, 1986.

COGLA, 1990a, MODU Supplementary Instructions/MANMAR, Ottawa.

COGLA, 1990b, MODU Supplementary Instructions/SAWRS, Ottawa.

Forrester, W.D., 1983, Canadian Tidal Manual, Canadian Hydrographic Service, Ottawa, 138 pp.

Forrester, W.D., 1982, Central Archiving of Current Meter Data Summaries, Canadian Contractor Report of Hydrography and Ocean Sciences, No. 7, MEDS.

Godin, 1982, An Alternative Analysis Procedure for Wave Spectra, Canadian Contractor Report of Hydrography and Ocean Science, No. 2, 32 pp.

MEDS, 1985a, Manual for the Preparation of Wave Measurements in GF-3 Format, Ottawa, 45 pp.

MEDS, 1985b, Manual for the Preparation of Moored Current Meter Data in GF-3 Format, Ottawa, 35 pp.

MEDS, 1993, Manual for Preparation of Acoustic Doppler Current Profiler Data in GF- 3 Format. Ottawa. 42 pp. Draft dated 09 June 1993.

UNESCO, 1981, UNESCO Technical Papers in Marine Science 37, Paris, pp 13-18.

Wilson and Baird, 1981, Canadian Wave Climate Study: Organization and Operation, Manuscript Report series No. 59, Marine Science and Information Directorate, 91 pp.

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Table II

DEPARTMENT OF FISHERIES AND OCEANS CONTACTS

Address	Area Code	Phone Number	Fax Number
Director Marine Environmental Data Service Department of Fisheries and Oceans Suite 1202, 200 Kent Street Ottawa, Ontario, K1A 0E6	613	990-0264	990-5510
Marine Assessment and Liaison Division Bedford Institute of Oceanography P.O. Box 1006 Dartmouth, Nova Scotia, B2Y 4A2	902	426-3246	426-8484
Director General Quebec Region Department of Fisheries and Oceans P. O. Box 15500 Quebec, Quebec, G1K 7Y7	418	648-4014	648-4470
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
Chief, Data Assessment Division	604	363-6335	363-6479

Institute of Ocean Sciences P. O. Box 6000 Sidney, British Columbia, V8L 4B2			

Table III

ATMOSPHERIC ENVIRONMENT SERVICE AND TRANSPORT CANADA CONTACTS

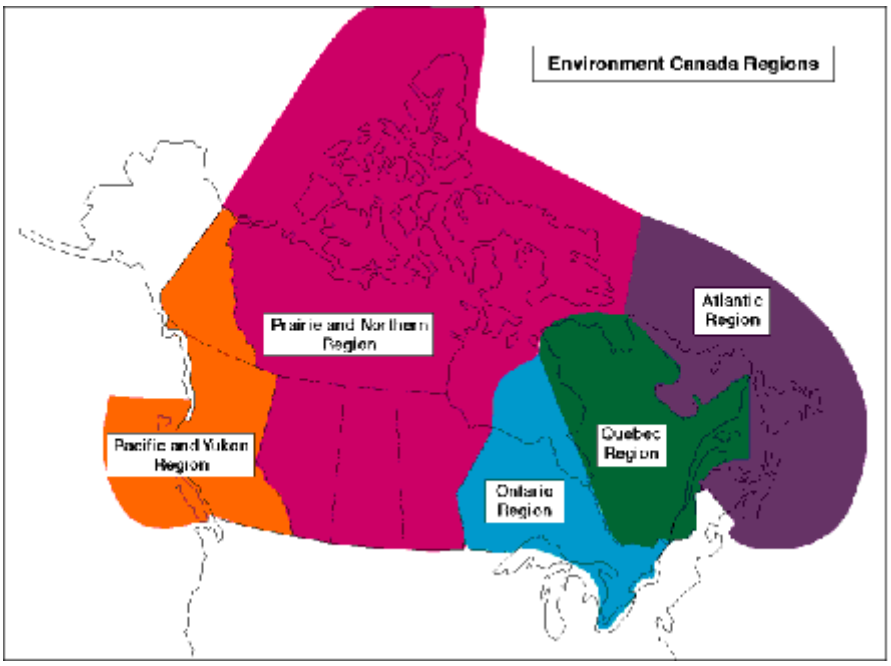
AREA OF OPERATION (See attached map)		**ATMOSPHERIC ENVIRONMENT SERVICE**		
Area	**Address**	**Area Code**	**Phone Number**	**Fax Number**
Headquarters	Director General National Weather Service Atmospheric Environment Service 4905 Dufferin Street Downsview, Ontario, M3H 5T4	416	739-4938	739-4967
Headquarters	Director Integrated Monitoring Atmospheric Environment Service 4905 Dufferin Street Downsview, Ontario, M3H 5T4	416	739-4965	739-4261
Atlantic	Regional Director General Environment Canada, Atlantic Region 15th Floor, Queen Square 45 Alderney Drive Dartmouth, Nova Scotia, B2Y 2N6	902	426-7475	426-5168
Québec	Directeur général régional Environment Canada La région du Québec 1141 rue de l'Eglise Sainte-Foy, Quebec, G1V 4H5	418	648-4077	649-6674
Ontario	Regional Director General Environment Canada Ontario Region 25 St. Clair Avenue East, 6th Floor Toronto, Ontario, M4T 1M2	416	973-6540	954-4963
Prairie and Regional	Director General Northern Environment Canada Prairie and Northern Region Twin Atria Building 4999 - 98 Avenue, 2nd Floor Edmonton, Alberta, T6B 2X3	403	495-4529	495-4367
Pacific and Regional	Director General Yukon Environment Canada Pacific and Yukon Region 224 West Esplanade	604	666-5881	666-4707

	Vancouver, British Columbia, V7M 3H7			
ICE All regions	Director Ice Services Atmospheric Environment Service Environment Canada 373 Sussex Drive La Salle Academy, Block E Ottawa, Ontario, K1A 0H3	613	996-5088	563-8480
ICE	Chief Ice Forecasting Central Atmospheric Environment Service Environment Canada 373 Sussex Drive La Salle Academy, Block E Ottawa, Ontario, K1A 0H3	613	996-4214	563-8480

TRANSPORT CANADA

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
Hudson Bay (Eastern)	Regional Superintendent Air Carriers Operations Transport Canada Suite 300, 4900 Younge Street Willowdale, Ontario, M2N 6A5	416	224-3765	224-4711
Hudson Bay (Western)	Regional Superintendent Air Carriers Operations Transport Canada P. O. Box 8550 333 Main Street Winnipeg, Manitoba, R3C 0P6	204	983-1409	983-1734
Québec	Regional Director Air Carriers Operation (NAX) Transport Canada 700 rue Leigh Capreol Dorval, Québec, H4Y 1G7	514	633-2836	633-3696

ENVIRONMENT CANADA REGIONS


Environment Canada Regions
Atlantic Region
Prairie and Northern Region
Pacific and Yukon Region
Quebec Region
Ontario Region