APPENDIX 1
SURVEY PLANNING AND ESTIMATION GUIDE

PART I PRE-SURVEY ACTIVITY

1. Can the positioning be calibrated and validated near the survey ground?
   If not, calibrate as near to the area as possible.
   Can a reconnaissance party go in advance? If yes, then time for recce at step 3 will be much reduced.

2. Estimated time of departure from the base port .....
   Passage time in hours .....
   Passage observations required? Yes/No
   Estimated time of arrival at the survey area .....
   NB: Allow time to test and tune sensors on passage.

3. Local liaison and reconnaissance. ..... days
   Calibrate positioning system if required.
   Can tide gauge(s)/pole(s) be established concurrently?
   If yes, cancel step 4.

4. Establish tidal station(s). ..... days

5. Establish sufficient geodetic control. ..... days
   (to include GPS observations if required)
   and set up navaids to start ship/boat work.
   Can this be done concurrently with 3 or 4?
   If yes, cancel step 5.

6. Calibrate positioning system within survey limits.
   Number of calibration stations .....
   Time per station ..... Total ..... hrs
   Total passage between stations ..... hrs
   Total...../24 ..... days

7. Obtain first set of sound velocity observations
   throughout the survey area.
   Can this be combined with navaid calibration?
   If yes, cancel 7. ..... days

TOTAL ..... days A*

PART II LINE MILEAGE TOTE

Average length of standard spaced sonar/sounding main lines ..... nm x no of lines .....
Divide by planned speed of advance ..... knts =

time taken ..... hrs

Turning time at end of line ..... mins x no. of lines/60 ..... hrs

subtotal (i) ..... hrs

Repeat for open spaced lines — subtotal (ii) ..... hrs

Interlines — subtotal (iii)..... hrs

Crosslines — subtotal (iv)..... hrs

Other sounding only lines — subtotal (v) ..... hrs

SUBTOTAL (ship) ..... hrs

% for shoal examinations ..... add to get — TOTAL (ship) ..... hrs

Divide by no. of productive hours per day (any restrictions?)

TOTAL (ship) ..... days B*

Repeat assessment for boatwork — TOTAL (boat) ..... days C*

Can boatwork be conducted concurrently with shipwork? If yes, then total C* can be subsumed: (in the plan include total B or C, whichever is greater, providing boat and ship work are not mutually exclusive).

OR

For oceanographic cruises the calculation will concern the number of observation stations, time to conduct each 'cast' and transit time between stations. Similarly the above format can be adapted for geophysical surveys.

PART III OTHER OBSERVATIONS AFLOAT

No of seabed samples .....x time per sample mins/60	=.....hrs
Distance between samples .....nm x no /SOA(...Knots)	=.....hrs
Total/productive hours per day	= .....days D*
No of wrecks requiring sweeping by wire..... No of wrecks swept per day.....	Subtotal .....days
No of wrecks requiring investigation..... Time per investigation plus transit time.....hrs Divide by productive hours per day ..... to give	Subtotal.....days
Repeat for disproving searches	Subtotal.....days
	TOTAL .....days E*
No of tidal stream observations ..... Time per observation plus transit hrs/24	TOTAL.....days F*
No of buoys requiring fixing..... Time per buoys (ebb and flood) plus transit ..... Total time divided by productive hours per day	TOTAL .....days G*
Other observations (eg) Photographic Views & Miscellaneous Tasks	TOTAL .....days H*
Total Field Work Afloat B* to H*	TOTAL.....days I*

N.B. If the boat can be used for some of these, the total will be reduced by that proportion. Note that a productive working day for a worked up boat will seldom exceed 6 hours. Similarly if there is more than one unit available for the survey, the total time taken will be reduced. In this case, it is often the practice to divide the area into blocks and allocate individual units to blocks, ensuring a suitable overlap for comparison purposes. Each unit would then go through the detailed planning process for its own block.

PART IV FIELD WORK ASHORE

In addition to the initial geodetic control work ashore, the following should be considered:

Time spent to extend geodetic control .....days
Time spent to coordinate other objects .....days
No of miles of coastline to be fixed/miles per day …….....days

TOTAL.....…..days J*

If I* is greater than J*, then J* will be subsumed into the time for fieldwork afloat. Careful planning will reduce the unproductive transit time to land shore parties etc.

Time for post-survey calibration and recovery of equipment .....days K*

TOTAL FIELDWORK = B* + I* (or J if greater)+K* ….....days L*

PART V DOWNTIME

There are a number of factors that will increase the time taken to complete the survey. The following list gives some of the planning considerations, but there may be other relevant issues (e.g. working in pack ice):

Estimate:

Days lost through weather (e.g.Winter 25%? Summer 10%?). ….....days

Days lost through defects (Age/repair state/weather?) .....days

Days "lost" through planned non-surveying activity .....days

Days lost through unplanned activities (e.g. 10%) ….....days

TOTAL DOWNTIME .....days
M*

TOTAL DAYS ON SURVEY GROUND = L* + M* .....DAYS

TOTAL SURVEY TASK = A + L + M + Passage time to and from survey ground.

APPENDIX 2

TABLE 1

Horizontal Positioning Systems and Selection Criteria

Positioning System	Estimated Positional Accuracy in meters (to 95% confidence level)	Allowable for Survey Order			
		Special	1	2	3
Sextant Angle resection	2 – 10	No	No	Yes	Yes
Theodolite Angle Intersection	1 – 5	Yes (*)	Yes	Yes	Yes
Visual/Range Intersection	3 – 10	No	No	Yes	Yes
Tag line (dynamic)					
< 200 meters from baseline	1 – 2	Yes	Yes	Yes	Yes
> 200 and < 600 metres from baseline	2 – 6	No	Yes (*)	Yes	Yes
> 600 meters from baseline	6 – 50	No	No	Yes (*)	Yes
Angle/Range Intersection	0.5 – 3	Yes (*)	Yes	Yes	Yes
EDM/Total Station (within 2 Km. from ref.st.)	0.3 – 1	Yes	Yes	Yes	Yes
EDM/Total Station (over 2 Km. from ref.st.)	1 – 3	No	Yes	Yes	Yes
High Frequency EPS (Microwave or UHF)	2 – 4	No	Yes	Yes	Yes
Medium Frequency EPS (HF)	3 – 10	No	Yes (*)	Yes	Yes
Low Frequency EPS (LF – Decca)	10 – 150	No	No	Yes	Yes
Very Low Frequency EPS (VLF - Loran)	45 – 310	No	No	No	Yes (*)
STARFIX	5	No	Yes (*)	Yes	Yes
GPS absolute SPS (with S/A up to May 2000)	75 – 100	No	No	No	Yes
GPS absolute SPS (without S/A)	10 – 30	No	No	Yes (*)	Yes
GPS absolute PPS	5 – 15	No	Yes (*)	Yes	Yes
DGPS code phase from local ref. station	2 – 5				
0 Km. < Distance < 2 Km.		Yes (*)	Yes	Yes	Yes
2 Km. < Distance < 100 Km.		No	Yes	Yes	Yes
DGPS code phase (Radiobeacon/WAAS)	2 – 10				
0 Km. < Distance < 250 Km.		No	Yes	Yes	Yes
250 Km. < Distance < 350 Km.		No	Yes (*)	Yes	Yes
RTK DGPS carrier phase from local ref. st.	0.1 – 1				
0 Km. < Distance < 20 Km.		Yes	Yes	Yes	Yes
20 Km. < Distance < 40 Km.		No	Yes	Yes	Yes

(*) Marginally

APPENDIX 3

TABLE 2

Bandwidth Classification of Electronic Positioning Systems used in Hydrographic Surveying

Bandwidth	Symbol	Frequency	System
Very Low Frequency	VLF	10-30 KHz	Omega
Low Frequency	LF	30-300 KHz	LORAN-C
Medium Frequency	MF	300-3000 KHz	Raydist, Decca
High Frequency	HF	3-30 MHz	Fundamental Earth Frequency 10.23 MHz
Very High Frequency	VHF	30-300 MHz	VOR Aircraft Navigation
Ultra High Frequency	UHF	300-3000 MHz	Del Norte
L-Band			NAVSTAR GPS
Super High Frequency	SHF	3-30 GHz	(Microwave EPS)
C-Band			Motorola
S-Band			Cubic
X-Band			Del Norte
Visible Light			EDM*
Laser Light			EDM
Infrared Light			EDM, Polarfix

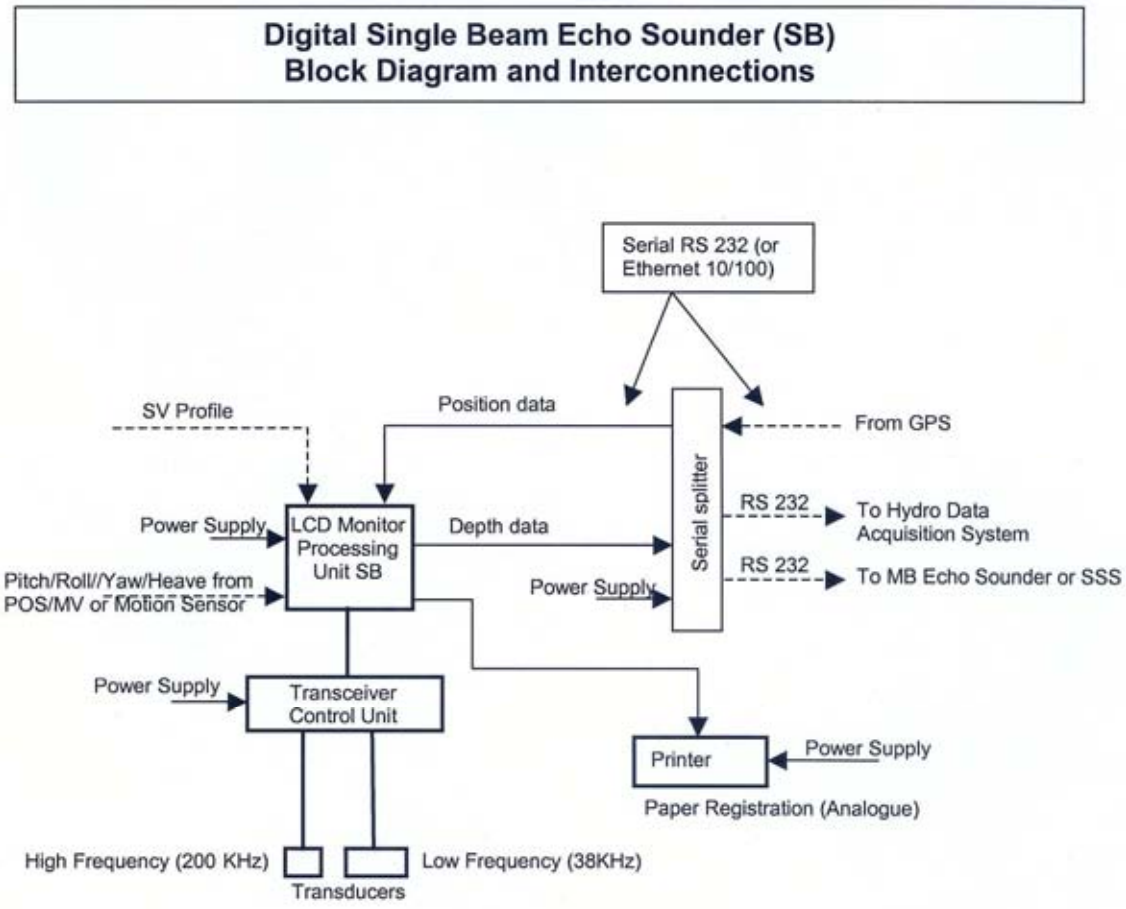
* Electronic Distance Measuring instrument.

TABLE 3

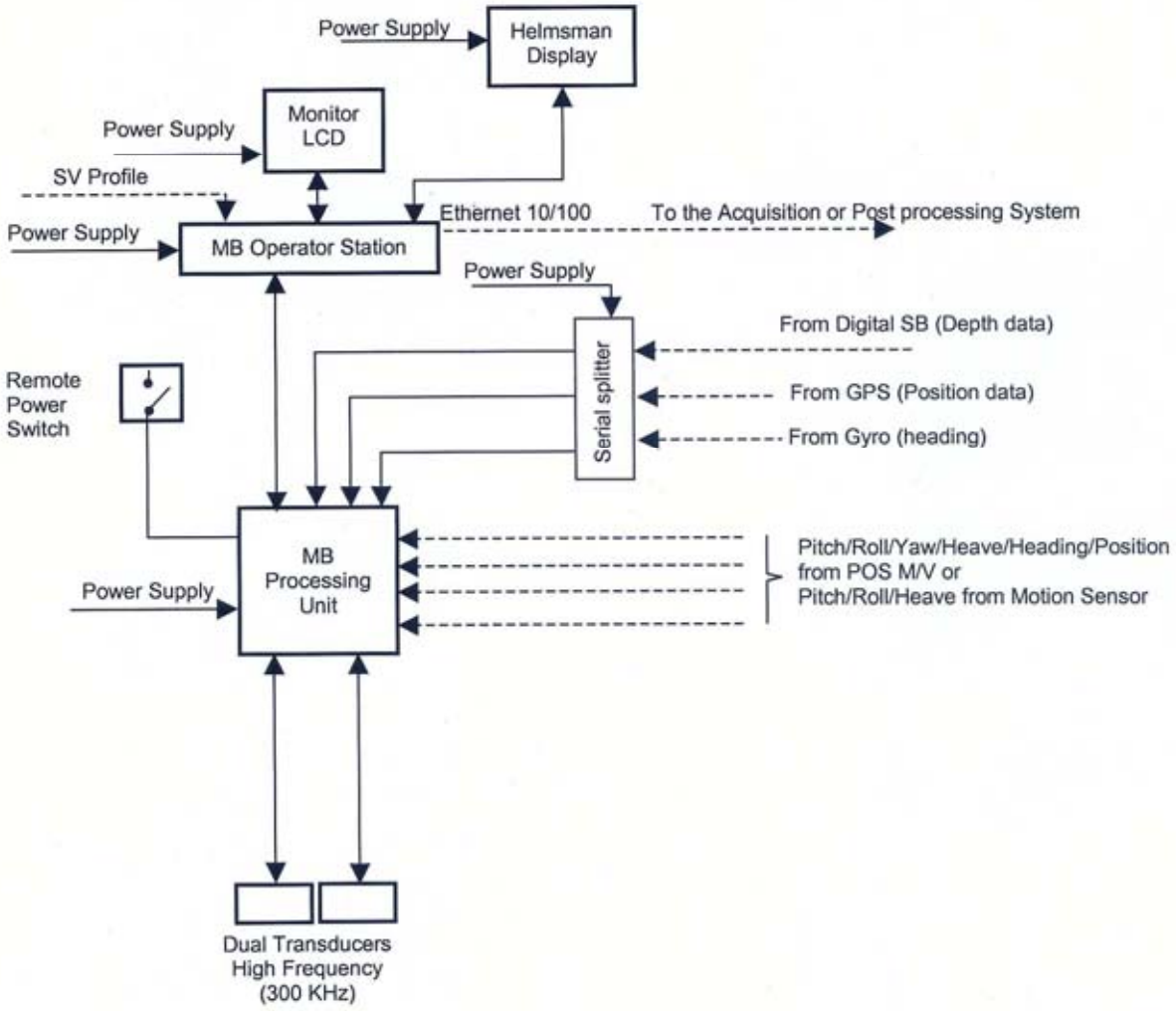
Field application of Electronic Positioning Systems used in Hydrographic Surveying

Frequency range	Type of System	Operable distance	Field application
Low and Medium frequency range	hyperbolic phase/ pulse differencing	They can reach far beyond the visible or microwave horizons	They were more suited for long-range navigation purposes or far offshore geophysical exploration work.
Super High Frequency (SHF) range	Microwave systems (circular phase)	Generally limited to line of sight	They are suitable for precise control of offshore survey vessels and dredges. The range is adequate to cover most river, harbour and coastal construction applications.
Modulated light wave and infrared spectrum	Electronic Distance Measurement EDM) instruments (e.g., electronic total stations)	Over relatively limited distances, usually less than 3 to 5 miles offshore	These systems provide the highest distance accuracy measurements for hydrographic surveys.

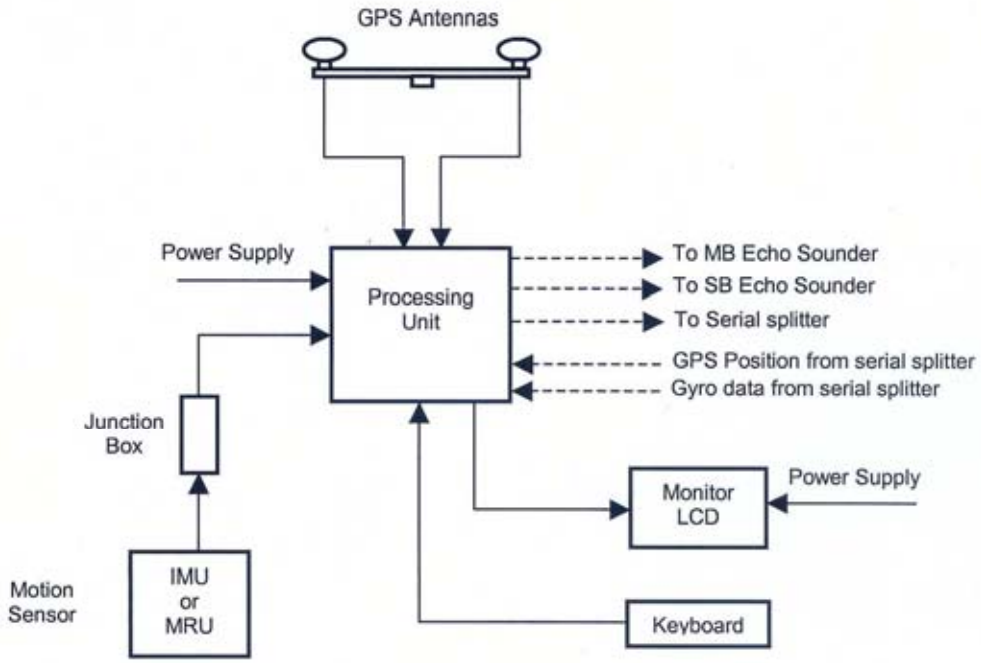
APPENDIX 4

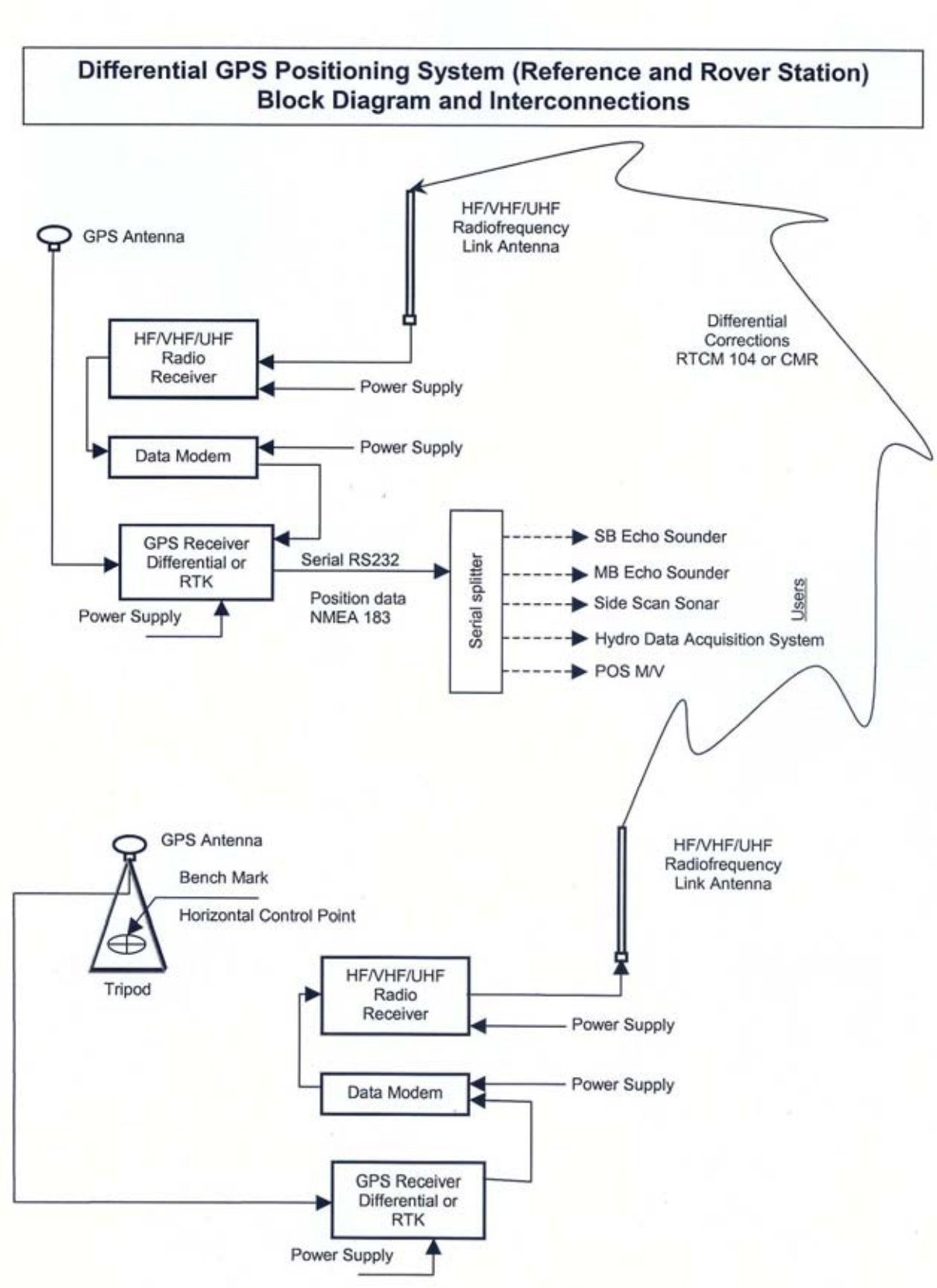

Digital Single Beam Echo Sounder (SB)
Block Diagram and Interconnections
Serial RS 232 (or Ethernet 10/100)
SV Profile
Position data
From GPS
Serial splitter
Power Supply
LCD Monitor Processing Unit SB
Depth data
RS 232
To Hydro Data Acquisition System
Pitch/Roll//Yaw/Heave from POS/MV or Motion Sensor
Power Supply
RS 232
To MB Echo Sounder or SSS
Power Supply
Transceiver Control Unit
Printer
Power Supply
Paper Registration (Analogue)
High Frequency (200 KHz)
Low Frequency (38KHz)
Transducers

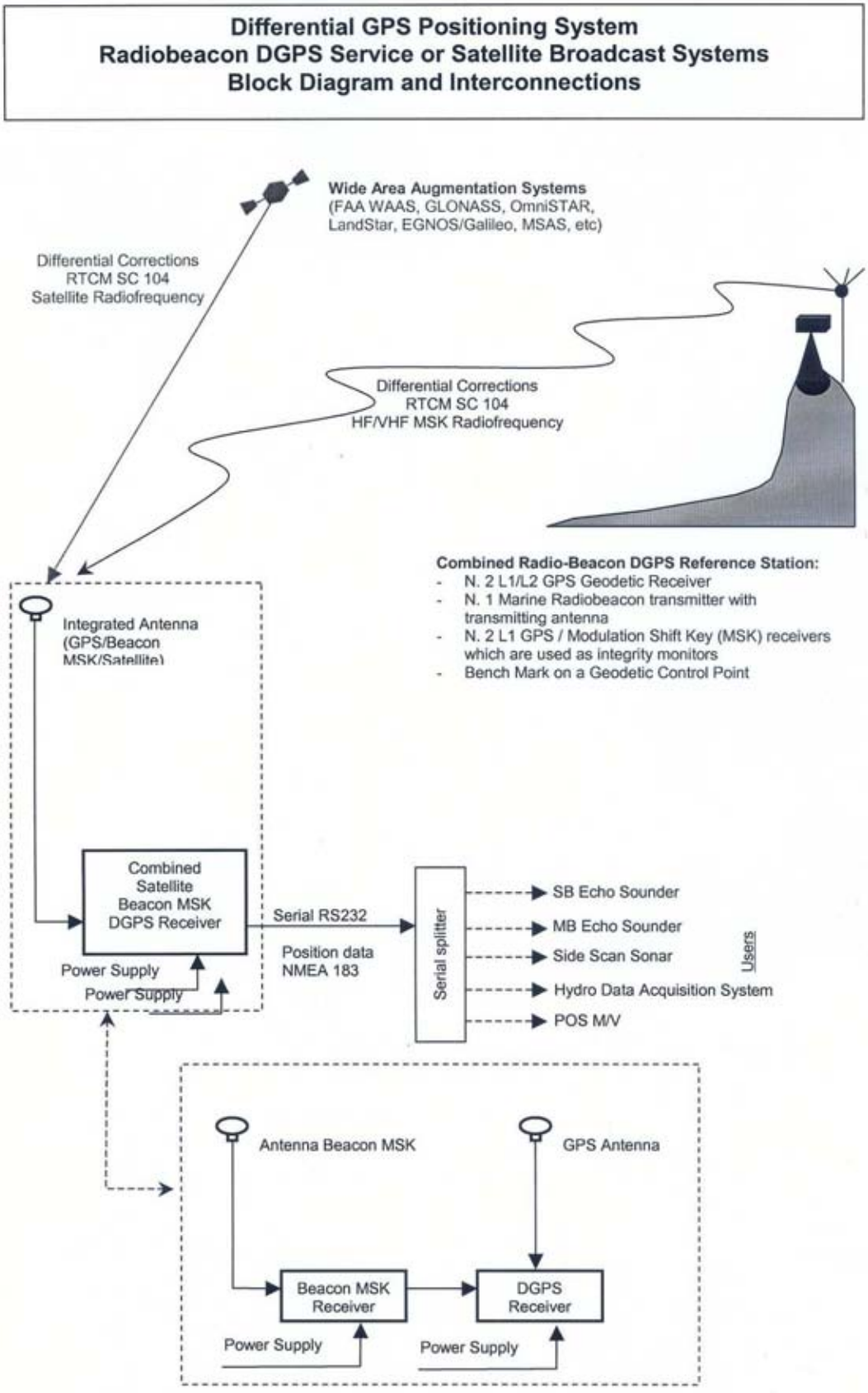
Digital Multi Beam Echo Sounder (MB)
Block Diagram and Interconnections



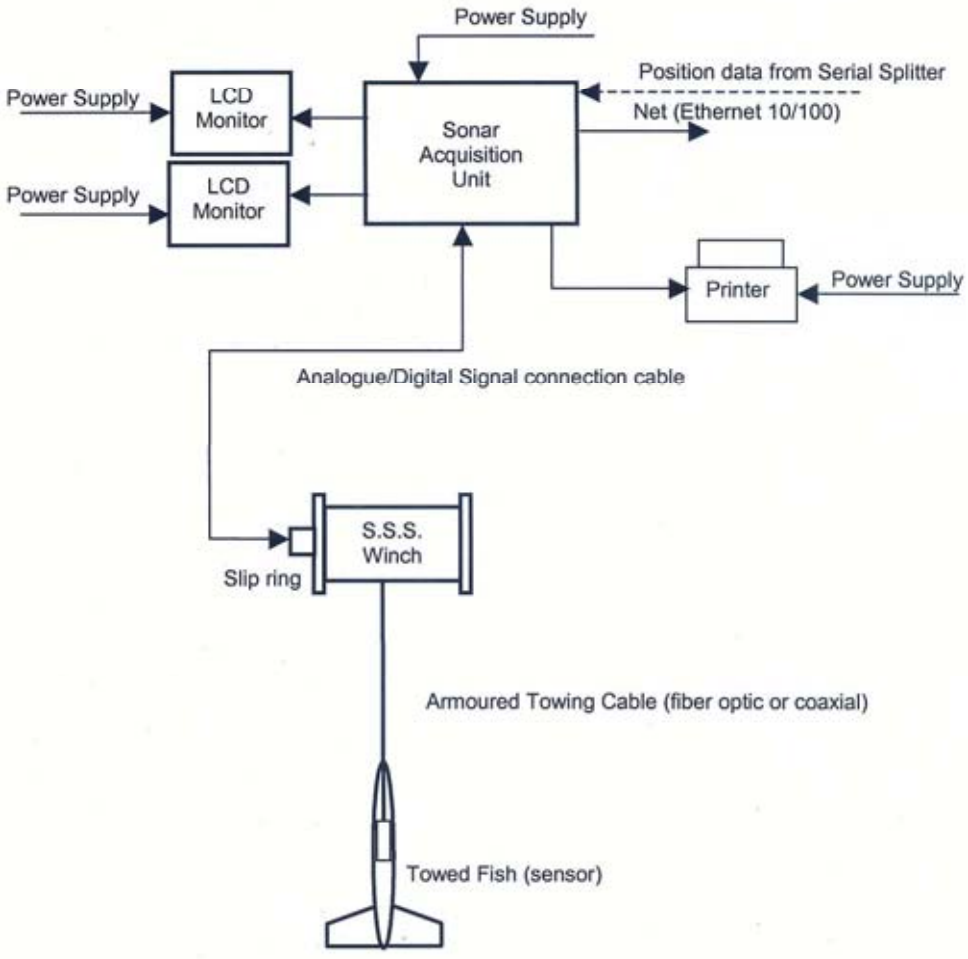
Integrated Position and Orientation System for Motor/Vessel (POS M/V)
Block Diagram and Interconnections



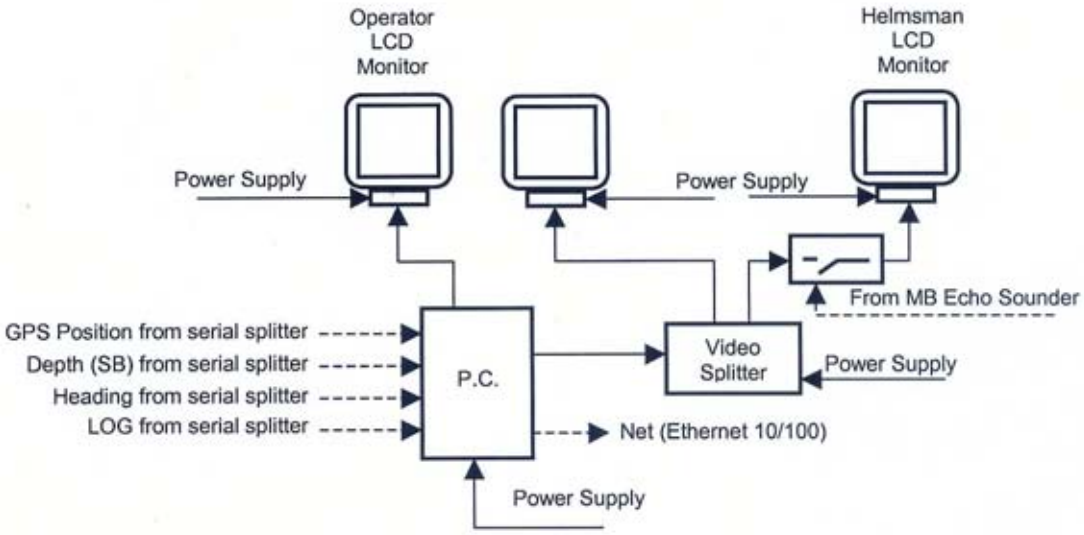

Differential GPS Positioning System (Reference and Rover Station)
Block Diagram and Interconnections
GPS Antenna
HF/VHF/UHF
Radiofrequency
Link Antenna
Differential
Corrections
RTCM 104 or CMR
HF/VHF/UHF
Radio
Receiver
Power Supply
Data Modem
Power Supply
GPS Receiver
Differential or
RTK
Serial RS232
Position data
NMEA 183
Power Supply
Serial splitter
SB Echo Sounder
MB Echo Sounder
Side Scan Sonar
Hydro Data Acquisition System
POS M/V
Users
GPS Antenna
Bench Mark
Horizontal Control Point
Tripod
HF/VHF/UHF
Radiofrequency
Link Antenna
HF/VHF/UHF
Radio
Receiver
Power Supply
Data Modem
Power Supply
GPS Receiver
Differential or
RTK
Power Supply


Differential GPS Positioning System
Radiobeacon DGPS Service or Satellite Broadcast Systems
Block Diagram and Interconnections
Wide Area Augmentation Systems
(FAA WAAS, GLONASS, OmniSTAR,
LandStar, EGNOS/Galileo, MSAS, etc)
Differential Corrections
RTCM SC 104
Satellite Radiofrequency
Differential Corrections
RTCM SC 104
HF/VHF MSK Radiofrequency
Combined Radio-Beacon DGPS Reference Station:
- N. 2 L1/L2 GPS Geodetic Receiver
- N. 1 Marine Radiobeacon transmitter with transmitting antenna
- N. 2 L1 GPS / Modulation Shift Key (MSK) receivers which are used as integrity monitors
- Bench Mark on a Geodetic Control Point
Integrated Antenna
(GPS/Beacon
MSK/Satellite)
Combined
Satellite
Beacon MSK
DGPS Receiver
Power Supply
Power Supply
Serial RS232
Position data
NMEA 183
Serial splitter
SB Echo Sounder
MB Echo Sounder
Side Scan Sonar
Hydro Data Acquisition System
POS M/V
Users
Antenna Beacon MSK
GPS Antenna
Beacon MSK
Receiver
DGPS
Receiver
Power Supply
Power Supply

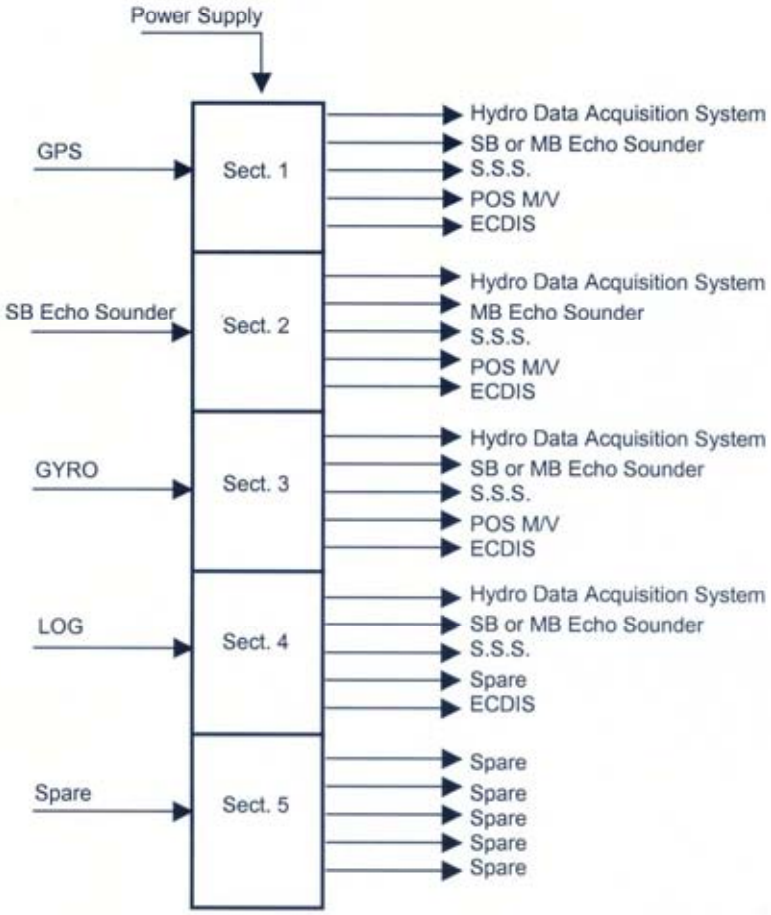
Side Scan Sonar System
Block Diagram and Interconnections



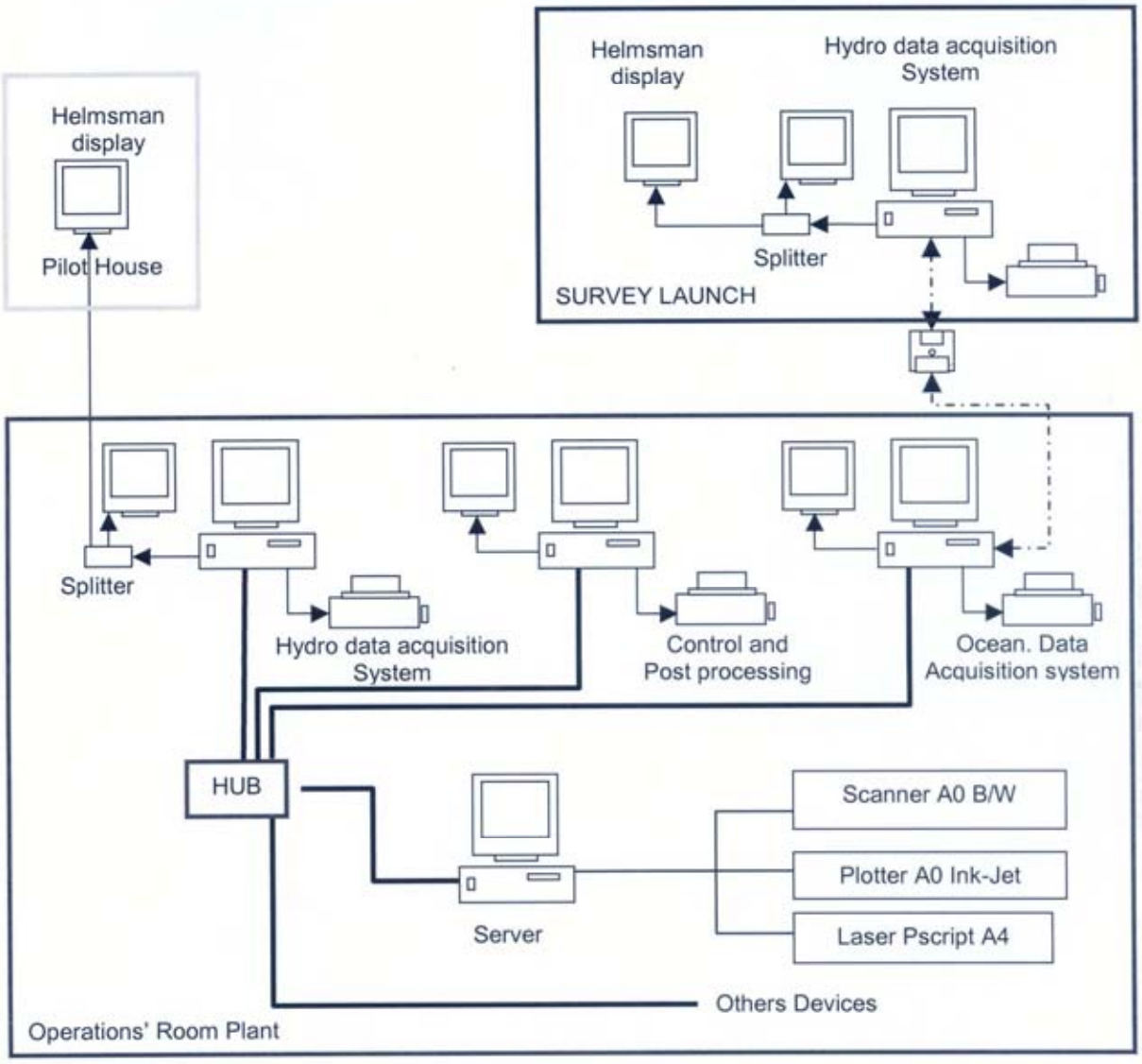
Hydrographic Data Acquisition System (Hardware/Software) Block Diagram and Interconnections



Serial Splitter Interface
Block Diagram and Interconnections



Typical Automated Hydrographic Systems Configuration (HW/SW)
Block Diagram and Interconnections



APPPENDIX 5
SPECIMEN REPORT OF SURVEY

ENGLAND, SOUTH COAST

APPROACHES TO DEEPWATER SOUND

SURVEYING VESSEL *[Name]*

SURVEYED BY *[Name of Surveyor]*

[Start and End Date of Survey]

1:25,000

REPORT OF SURVEY

[Date of Report] *[Survey Reference Number]*

CONTENTS

PART 1 - DESCRIPTIVE

PART 1

1. Introduction

1.1 Give start and finish dates. Remark on any general service activities which interrupted the progress of the survey.

1.2 Give a general statement on the weather, including the seasonal climate and variations experienced. Comments on weather are essential when surveying unstable, critical areas which require optimum hydrodynamic conditions to determine the absolute minimum depth over each feature. Comments are also required on how the weather affected the quality of the data – e.g. ship motion and heave compensator performance, degradation of sonar search, stability of navaid in storms, effect of sea conditions on sandwave heights.

1.3 Comment on any extraneous activities (e.g. firing ranges or saturation fishing) which affected the conduct of the survey. Mention whether the strength of the tidal stream caused any particular difficulties. Mention any logistic problems.

1.4 Give the overall opinion of the completeness of the survey. Identify any areas which require further surveying.

2. Geodetic Control

2.1 State how much existing geodetic control was used and explain how any new control was established; give a general statement on the degree of accuracy achieved and outline any difficulties encountered in linking to existing control.

3. Digital Surveying System

3.1 State which systems and issues of software were used, if appropriate. Comment on any enhancements implemented during the survey, giving dates when installed.

3.2 Mention any major difficulties experienced or defects that had a significant impact on the progress or quality of the survey and venture an opinion of the effectiveness of the systems used. There is no requirement to include details of minor defects.

3.3 A statement is to be made to the effect that all significant depths detected by the echo sounder are represented on the digital records, indicating how this has been achieved. Reasons must be given if this check has not been carried out.

4. Navaids

4.1 State the type and operating modes of the systems used.

4.2 Where a DGPS solution utilises a network of reference stations, comment upon the reference station network geometry and reference station ranges, with respect to the survey area. If a single reference station DGPS solution is used in preference to a network solution state why.

4.3 Describe how and when the systems were calibrated and/or validated.

4.4 Give the Surveyor's opinion of the quality and reliability of the equipment, and the accuracy's achieved. Comment upon any periods of poor positioning quality observed. Include details of any GPS reference station failures or incidences of abnormally high latency in the delivery of pseudo range corrections.

5. Bathymetry

5.1 State the type of echo-sounder used and its transmission frequencies, especially where dual frequency sets are used. State the result of ship squat trials conducted. State the type of heave compensation used and give a brief summary of its performance.

5.2 State the method of obtaining sound-velocity (SV) and the frequency of SV and bar-check observations; give an opinion of their accuracy. Quote the mean SV used, if appropriate.

5.3 State the sounding line direction, line spacing and average speed over the ground. For shoal investigations etc, quote the density of the sounding lines and the seabed footprint of the echo sounder beam.

5.4 Describe any Leading Lines or Recommended Tracks.

5.5 Give the Surveyor's estimation of the overall accuracy of the soundings, drawing attention to reasons why the desired accuracy standard may not have been met. Include an opinion of the thoroughness of the survey with regard to the line density.

(See also paragraph 8 (Seabed Topography and Texture - Comparison with Previous Surveys) and paragraph 9 (Tides and Sounding Datum - Scrutiny of Cross-line intersections); these will have a bearing on the estimated accuracy of the sounding, the assessment of the accuracy of the co-tidal chart, and on the Charge Surveyor's general opinion of the completeness of the bathymetry and assessment of further work necessary).

6. Sonar

6.1 State the type of sonar used and its transmission frequency.

6.2 Mention the type and frequency of confidence checks carried out. Include the Surveyor's opinion of the quality and reliability of the sonar equipment.

6.3 State the choice of sonar line direction, line spacing, sonar range, and mean SOA. Give an estimate of the effect of tidal streams on the lateral position of the towfish and describe any precautions taken to ensure complete sonar coverage.

6.4 State the allowance made for sonar layback at the ends of lines and whether the extra line was run outside the required survey area limits to achieve the sonar search specified in the survey specification.

6.5 Give the Surveyor's opinion of the thoroughness of the sonar coverage and a definitive statement of the extent of the search achieved.

7. Seabed Sampling

7.1 State the sampling interval and comment upon any particular samples obtained on interesting features. Describe any reservations the Surveyor may have concerning the distribution of sediments as portrayed by the samples obtained. Quote the number of samples retained.

7.2 State the method of sampling used and mention any problems with the equipment.

8. Seabed Topography and Texture

8.1 Give a brief thumb-nail sketch description of the seabed topography of the surveyed area. State the Charge Surveyor's opinion of all significant features, their nature and distribution throughout the survey area. Comment on any difficulties experienced in interpreting the sonar trace when preparing the textures tracing.

8.2 State the reason if unable to investigate a shoal as thoroughly as desired and estimate the reliability of the least depth obtained; identify the extra work needed to ascertain the absolute least depth:

e.g.: 'the shoal was thoroughly examined by echo sounder but due to the likelihood of a rock pinnacle, it should be wire swept to guarantee obtaining the least depth. Adverse weather prevented this being completed during the survey.'

8.3 Comment on any areas of less than 40 metres depth which were not interlined.

8.4 Mention dredging activities and spoil grounds.

8.5 Comment on any movement of sandwaves when compared with previous surveys.

8.6 Give the Surveyor's opinion of the comparison with previous surveys and any doubts about the detection of all existing shoal depths, or recommendations for retaining previously surveyed depths. If it has not been possible to check and confirm or disprove every charted feature in the survey area, explain why.

8.7 Where it has proved impossible to sound a stretch of coastline because breakers appear to be a permanent feature this is to be noted in Annex N.

9. Tides and Sounding Datum

9.1 State where the tidal station was sited and how Sounding Datum was established. For an established gauge, describe how the setting of the zero was checked.

9.2 Describe any transfer of datum involved and any use made of co-tidal charts.

9.3 Describe any adjustment to the level of the Sounding Datum found necessary during the course of the survey.

9.4 State the types of tidegauge and/or tidepole used; state over what period observations were made and whether they were analysed.

9.5 Mention any tidegauge malfunctions and any difficulties in obtaining tide readings such as impounding or surging.

9.6 Quote the Standard Port used for predicted tides, or explain the use made of harmonic constants to derive tidal predictions.

9.7 Give the Surveyor's opinion of the accuracy of the levelling used to establish Sounding Datum and the accuracy of the tidal data in terms of both height and time. State the assessment, from careful scrutiny of cross-line intersections, of the accuracy of the tidal reductions after co-tidal corrections have been applied. (see paragraph 5).

10. Tidal Streams

10.1 State where, when and how, tidal stream observations were carried out. Mention any problems with the equipment.

10.2 Explain why a required tidal stream station was not observed or was observed in a different position from the one ordered.

10.3 If the observations were not taken at Springs, explain why not and estimate the consequential effect on the quality of the data rendered. State what analysis has been carried out.

10.4 Give a brief synopsis of the observations obtained and the Surveyor's opinion of the accuracy of the observations and the effects of the weather on the quality of the data.

10.5 If no observations were carried out, give a brief qualitative assessment of the tidal streams derived from experience of handling the ship on sounding lines, or from fishermen or others with local knowledge.

11. Wrecks and Obstructions

11.1 State the method of investigating wrecks and obstructions, including the techniques used for wire-sweeping and the number of wrecks/obstructions which were wire-swept.

11.2 Comment on any problems encountered with obtaining the least depths,

e.g. 'could not wire drift sweep because the wreck was at a nodal point'; or 'the weather was too rough for wire sweeping but least depth obtained by echo sounder was considered sufficient'.

11.3 Provide a general statement on details obtained from fishermen or others with local knowledge. If possible, provide a summary of the effect that certain weather conditions have on wrecks and obstructions.

11.4 Explain why a particular ordered wire-sweep was not carried out.

12. Lights and Buoys

12.1 Described how lights were checked and were fixed. If any new light has been established, it should be fully described using the format in the Light List, and the method of determining its position stated. (Details of the observations for position should appear in the Geodetic Data).

12.2 Whenever possible, the Authority responsible for establishing any new light or buoy should be quoted.

12.3 Describe how the position of each buoy was fixed on the flood and the ebb and quote the spread of position about the final accepted mean.

12.4 Give the Surveyor's opinion on the accuracy of the observations to determine light sectors and positions of navigational buoys. Give a positive statement to confirm the light characteristics shown on all the published charts that cover the survey area (Art 0309).

13. Coastline, Topography, Measured Distances, Conspicuous Objects and Marks

13.1 State whether the coastline was fixed in the field and if so by what method, or whether accepted from:

a. aerial photo plot - give details
b. maps - give details

13.2 State how heights were observed. Comment on any significant changes such as foreshore erosion or significant soft sediment build up.

13.3 Comment on any new man-made facilities such as marinas or jetties (which are also to be included in amendments to Sailing Directions).

13.4 Comment on any measured distances and marks indicating clearing lines, leading lines or recommended tracks, either found, or charted but no longer usable. Include full details in the amendments to the Sailing Directions and Annex M.

13.5 Remark on those objects considered to be conspicuous and objects charted as conspicuous but no longer worthy of the description. Include these in amendments to Sailing Directions and in Annex M.

13.6 Where an Aerial Photo Plot was provided, describe the way in which the data was checked in the field and draw attention to any major discrepancies found. Comment on the general utility of the plot.

14. Sailing Directions and Nomenclature

14.1 Comment that amendments were not needed, or that they are contained in Annex N. Draw attention to any major inaccuracies in the current Sailing Directions. Remark on photographs taken and the accuracy of those currently published in the Sailing Directions. State whether or not charted names have been checked, in so far as this is practicable, giving details of how this was done. When one set of amendments covers two or more surveys, or a survey rendered in two or more parts with separate reports, a

reference is to be included in each report indicating where the Amendments to Sailing Directions may be found.

14.2 Remark on any new names proposed.

14.3 List copies of port handbooks, guides etc obtained during the course of the survey and forwarded with the Report of Survey.

15. Radio Signals

15.1 Provide a general statement on the accuracy of data contained in ALRS that applies to the area surveyed and ports visited.

16. Ancillary Observations

16.1 Describe the observing techniques and venture opinions on the thoroughness of the observations used for any of the following:

a. Fresh Water Springs;
b. Overfalls, Tide Rips and Eddies**;**
c. Any special scientific observations ordered (e.g. magnetic variation).

17. Miscellaneous

17.1 Comment on any other facets of the execution and results of the survey which may be of value to the Hydrographic Office or of historic interest when reviewed in future years.

[Signature Block]

CONTENTS

PART 2 - TECHNICAL

Additional annexes, e.g. copies of communication with the Hydrographic Office, may be added as required.

ANNEX A TO
[Report of Survey Reference]
[Date]

Accompanying Documents

A.1 List all the documents and records accompanying the Report of Survey. For example:

a. Bathymetric Sheet;
b. Seabed Texture Tracing;
c. Sounding Track Plot
d. Sonar Track Plot;
e. Contour Tracing;
f. Miscellaneous Tracing(s) - Co-tidal Corrections, Floating Navigational Marks, Names, etc;
g. Wreck Cards/Records;
h. SV Probe Data Tapes;
i. List of Digital Data Tapes
etc

A.2 Provide a statement on the neatness and accuracy of tracings if appropriate. If several staff have been employed on a particular tracing, the division of labour is to be described.

ANNEX B TO
[Report of Survey Reference]
[Date]

Digital Surveying System

B.1 Include a brief description of:

a. System hardware;
b. Software version number;
c. Main software functions;
d. Applications of software;
e. Any major difficulties encountered.

B.2 Include:

a. Diary of all defects that had a significant impact on the conduct of the survey;

b. Details of the variables and parameters used during logging and processing;

c. A diagram illustrating all laybacks.

B.3 The total number of DATA files created is to be stated. if any file was not rendered, e.g. because it was corrupted. a brief explanation is to be given.

B.4 Processing (Track)

a. A statement that no recalculation of position was undertaken or details of any lines where recalculation of position was necessary;

b. Details of any major track editing - other than the removal of the occasional spurious position.

B.5 Processing (Depth)

Details of processing parameters used during the survey. Variations from standard methods and procedures set for the processing system in use to be explained.

B.6 Details of any digital terrain or elevation models produced:

a. Name
b. Origin
c. Azimuth
d. Height and width
e. Bandwidth and number of bands
f. Character size used
g. Confirmation that 'selected soundings only' have been used
h. Details of any polygon clipping used to plot to the bathymetric sheet.

B.7 Grid

a. Name
b. Origin
c. Height and width
d. Number of squares, square size and search distance

B.8 If any variations from standard procedure were adopted they are to be described in detail. in particular, the following should be noted.

a. The manual adjustment of any selected depths. Any major manual reselection of the soundings selected by the automatic sounding selection process.

b. The addition of any depths to the bathymetric sheet which are not included in the digital record. A list of all individual depths or the co-ordinates of the limits of blocks of manual data are to be provided.

c. The editing out of any invalid depths from the digital model

B.9 Print-outs of Job Configurations used during survey.

ANNEX C TO
[Report of Survey Reference]
[Date]

Geodetic Data

Section 1 - Description of Observations

C.1.1 This should be a comprehensive description of the methods and instruments used for observing the control. The type of equipment and the mode in which it was used should be carefully described. The name and versions of any computer programs used for the reduction of observations, or any other type of processing or transformation should be detailed. Difficulties encountered and how overcome, together with remarks on accuracy achieved should be included.

Section 2 - Horizontal Datum, Spheroid, Projection and Grid Details; List of Coordinates

C.2.1 Horizontal datum, projection and grid details will normally have been stated in the geodetic appendix to the survey specification. These should be repeated at the beginning of this section, examples being:

> `All control is referred to World Geodetic System 1984 Datum, World Geodetic System 1984 Spheroid; grid coordinates are given in terms of the Transverse Mercator Projection, UTM Grid Zone 21 South (Central Meridian 057°W).'

or

> `All control is referred to ETRS89 Datum, GRS80 Spheroid; grid coordinates are given in terms of the Transverse Mercator Projection, UTM Grid Zone 31 North (Central Meridian 003°E).'

Exceptionally, where no suitable horizontal datum is already established, the details required are to be stated in full.

C.2.2 Stations are to be listed, in tabular form as an Annex to the Report of Survey, see example at the end of this outline Annex. For each station, the information required is:

a. Distinguishing letter;

b. Full name;

c. Field name and/or GPS SITE number;

d. Source for old stations. Estimated error for new or re-occupied stations. If the sources for horizontal position and height are different, both should be quoted;

e. Geographical co-ordinates. Coordinates should not be quoted to a greater precision than that justified by their estimated error. Coordinates accepted from other sources should be in bold and underlined.

f. Grid coordinates. Coordinates should not be quoted to a greater precision than that justified by their estimated error. Coordinates accepted from other sources should be in bold and underlined.

g. Spheroidal height in metres;

h. Orthometric height in metres.

C.2.3 Stations determined independently of the main control network are to be clearly distinguished, and their source stated. They should be listed separately in a table, a suggested format is at Annex A of this section.

C.2.4 Any heights observed should be clearly tabulated and their source stated. The vertical datum used should be stated together with details of the method used, whether the heights are orthometric or spheroidal and the geoid/spheriod separation used, together with its source.

Section 3 - Descriptions of Stations

C.3.1 List any known geodetic stations which no longer exist and explain why.

C.3.2 Descriptions of stations should be rendered for all recoverable stations; amendments found to be necessary to descriptions of previously established stations should also be rendered. If a previously established station cannot be recovered, this is to be stated giving suggested reasons for the problem. The descriptions of the station mark itself, its immediate locality and the general area are to be as thorough and detailed as possible, to enable the station to be both identified on aerial photography, and also recovered on the ground.

C.3.3 Aerial photographs of the general locality, on which stations have been very accurately pricked through, should be supplied where possible. Ground, or preferably low aerial, photographs should also be used to illustrate the stations themselves.

C.3.4 Pre-marked control points for air photography should be photographed at altitude intervals of 1000 feet up to 4000 feet. This may be achieved by either air survey cameras or a hand held camera. At least two shots at each altitude from different positions as near vertical as possible should be taken. At least one pair of photographs should include some coastline, if possible. All control photography should be recorded with a Photographic Reconnaissance Report. Prints made of control photography should be full frame, if possible.

C.3.5 All diagrams and photographs should be black and white, and be drawn or selected with a view to their legibility when reproduced. Views should be annotated with: survey specification number; station name and letter; date and reference to Report of Survey. If labels are used, it is recommended that they be stuck on the reverse.

Section 4 - Abstract of observations

C.4.1 The following sub sections should be completed where appropriate.

a. Angles - This section is to contain a set of observation forms, one (or more) for each station occupied. All observed horizontal angles are to be recorded, including any not used in the field adjustment, to permit later, more rigorous, Hydrographic Office adjustment. An estimate of the error in each final reduced grid circle reading should be

stated. Corrections for t-T should be shown for each ray, including that to the Reference Object. Vertical angles should be shown separately.

b. Distances - This section should contain full details for the measurement of each line. All observed distances should be recorded, including any not used in the field adjustment, to permit later, more rigorous, Hydrographic Office adjustment. In all cases, the derivation of the final reduced grid distance from the raw instrument readings must be clear and unambiguous. Care must be taken that the scale factors are applied the correct way round. An estimate of the error in the result should be included. Full details of the methods used, and the corrections applied, should be given in the case of distances measured by other means. Details of computer programs used to reduce the observations to the grid should be included, together with copies of any printer output.

c. Geodetic GPS This section should contain at least the following data:

(1) List of baselines observed including: Date and Julian Day No, Session Letter, Stations Observed.

(2) List of antenna heights for each observation (stating whether it is a slope, vertical or offset height).

(3) Pintout of ALL post processed GPS vector files used to determine coordinates;

(4) Floppy disk containing raw observational data;

(5) Floppy disk containing all post processed GPS files and network adjustment files. A backup copy of all data should be retained onboard until the survey has been fully appraised by the Hydrographic Office.

Section 5 - Description of Adjustment

C.5.1 A comprehensive description of the methods used for adjusting the control is required. Items to be rendered and their format will vary depending on national requirements.

C.5.2 For geodetic GPS schemes, only one known point need be held fixed in the adjustment process. Where further points in the scheme are known points, a comparison should be made between the computed coordinates as a result of the adjustment and the original known coordinates.

Section 6 – Transformation of Co-ordinates

C.6.1 Give full details of any transformations of co-ordinates that were undertaken. This should include the actual transformation parameters used and the software platform on which the calculations were performed.

Section 7 – Correspondence with other Surveying Authorities

C.7.1 Copies of all correspondence with local surveying authorities regarding geodetic control should be included in the Report of Survey.

Diagram of Control

1. A Diagram of Control should be produced manually when the software used to adjust the network does not have the facility to produce a network diagram. The Diagram of Control should be drawn on good quality paper and bound with the Report of Survey. The size of the diagram should be sufficient to allow all observations to be distinguished easily and with the station names shown clearly. Its folded size should ideally not exceed A4; areas of dense control may be shown as larger scale insets, or separately, to aid clarity. A scale and a graticule should be included. It is recommended that stations accepted from previous work should be shown in red, and all others in black.

2. The types of observations are to be clearly distinguishable. For example, observed angles may be indicated by small arcs joining the defining rays; observed distances may be indicated by doubled rays; GPS vectors may be indicated by red lines.

LIST OF CO-ORDINATES AND HEIGHTS

SITE (Letter)/Full Name/[Field Name] [GPS Number]	Source for old stations. Estimated error for new or re-occupied stations	WGS 84 Datum, UTM grid zone 21 South, Central Meridian 57º West					
		Latitude (South)	Longitude (West)	Eastings (metres E)	Northings (metres N)	Spheroidal Height (metres)	Orthometric Height (metres)
(A) Mount Round [ROUND] [2502]	Fl 360 E FL/5-P22	51º 36' 08".6352	57º 58' 54".0517	432012.40	4282726.15	168.80	155.48
(B) Mount Brisbane [BRISBANE] [2501]	Fl 360 E FL/1-P26	51º 29' 22".000	57º 55' 58".372	435231.84	4295332.16	187.50	173.88
(C) Port Long [LONG] [2503]	< ± 0.1 (1σ) metre	51º 33' 24".124	58º 25' 34".678	425025.37	4299045.83	22.45	20.43
(D) Icy Point [ICY] [2504]	< ± 0.1 (1σ) metre	51º 36' 36.016	58º 57' 54".879	425609.24	4300005.67	38.91	18.22

ANNEX D TO
[Report of Survey Reference]
[Date]

Navaid Calibrations and Validations

D.1 State types of navaid, frequencies and operating modes.

D.2 If using differential GPS, state which reference stations were used and give details.

D.3 Describe the calibration and validation methods used.

D.4 List all the navaid calibration / validation results including any computer printouts (if available) for all calibrations / validations carried out before, during and after the survey.

D.5 Where a precise navaid such as Trisponder is used to validate a DGPS navaid, full details of the calibration of the reference navaid should be included as well as details of the validation. Where a second DGPS navaid is used to validate the primary DGPS navaid it should be as fully independent a system as possible. The preferred method is to use post processed or real-time kinematic GPS for validations of DGPS navaids.

D.6 When using a data logging and processing system, a printout showing the navaid and system configuration should be included as an Appendix. Whenever there are changes to this, they should be recorded and a new printout obtained for record purposes. Where appropriate a statistical summary should be derived from the End-of-Line navaid LOP statistics, and included.

ANNEX E TO
[Report of Survey Reference]
[Date]

Sound Velocity and Bar-Check Observations

E.1 List the dates and results obtained for each observation.

E.2 When mean sound velocities have been calculated from expendable bathythermograph (XBT) observations, the consecutive numbers of the XBT observations and the assumed salinity values used must be included.

E.3 Record of CTDV Probe Casts

E.4 Record of Oceanographic stations Observations

E.5 Record of Sound Velocity Probe Observations.

(NB A copy of the appropriate forms should also accompany the magnetic data tapes which should be rendered to the Hydrographic Office with the Report of Survey).

ANNEX F TO
[Report of Survey Reference]
[Date]

Levelling and Tidal Observations

F.1 Quote the levelling results in the form of a diagram, and state clearly the value of Sounding Datum established.

F.2 Include the Record of Tidal Observations and the Record of Transfer of Sounding Datum - where appropriate.

F.3 Record of Daily Tidegauge Checks.

F.4 Results of 25 hour tidepole – tidegauge comparison.

F.5 When using an offshore seabed tidegauge data should be rendered according to national rules. For the Report of Survey should only be necessary to render a summary of observations in the following format:

Tidegauge Address	Position	Recording Period	Date Rendered	UKHO Reduction Figure

ANNEX G TO
[Report of Survey Reference]
[Date]

Accuracy of Soundings

G.1 State depth variation throughout the survey area and indicate the acceptable standard error which accrues.

G.2 List techniques adopted and the assessment of the standard errors achieved under each of the headings listed in the table below.

G.3 Set out, as in the table below, a listing of the standard error assessments for each of the tested criteria at the shoalest and deepest depths encountered and any intermediate depths where the error assessments change markedly. A brief explanation should be given for the assessment of each standard error.

Source	At Deepest Depth	At Intermediate Depth(S)	At Shoalest Depth
Echo Sounder TX Mark Setting			
Variation in TX mark setting			
SV Measurement			
Spatial Variation in SV			
Temporal Variation in SV			
Application of Measured SV			
Instrumental Accuracy			
Trace Resolution			
Heave			
Settlement and Squat			
Roll, Pitch and Seabed Slope			
Tidal Measurement			
Co-tidal Corrections			
Application of Tidal Reduction			
Trace Reading			
Combined Error = $\sqrt{\sum(x)^2}$			
Requirement = $\sqrt{\pm(0.5)^2 \pm (0.009d)^2}$			
Standard Met (Yes/No)			

ANNEX H TO
[Report of Survey Reference]
[Date]

Comparison with Published Chart

H.1 Draw attention to depth changes which may warrant promulgation by Notices to Mariners. For example:

a.	In depths 0 to 10 m	list depths shoaler than charted by at least 0.5m
b.	In depths 10 to 31m	list depths shoaler than charted by at least 1m
c.	In depths 31 to 200m	list depths shoaler than charted by 5% or more
d.	In depths 200 to 800m	list depths shoaler than charted by 10% or more

H.2 In high-risk areas where vessels operate regularly with minimum under-keel clearance, any shoaling of critical or controlling depths should be listed. Examples of such high-risk areas are: the Dover Strait TSS; Southern North Sea Deep Water Routes; within and adjacent to main channels in port areas and their approaches.

H.3 In the following areas, no more than a general description of the changes is required. However, the controlling depths must be clearly identified.

a. Areas of unstable seabed, where significant movement of features has occurred;
b. Complex areas, such as rocky seabeds;
c. Areas where new surveyed depths are shoaler than charted over a significant part of the survey area (even if the differences fall within the criteria in H.1. above).

H.4 It is important to give a firm recommendation on the charting action to be taken for charted dangers which have not been found during the survey. A danger will not be removed from the chart unless the recommendation is based on a full examination.

H.5 The horizontal reference datums of the positions of surveyed and charted features should be stated. Ideally these should correspond to the datums of the survey and chart, respectively.

H.6 Any 3D views created using the data processing systems should be included in this annex. It is recommended that each view be printed on A3 paper folded to fit within the Report of Survey with a title block showing:

a. The title of the respective bathymetric sheet;
b. Horizontal and vertical scales;
c. Viewing azimuth and altitude

ANNEX I TO
[Report of Survey Reference]
[Date]

Wrecks and Obstructions

I.1 List all wrecks located and examined under two separate headings:

a. 'Known Wrecks' (by name, where appropriate and position)
b. 'New Wrecks' (by position) and cross reference to rendered wreck data.

I.2 Comment on all wrecks listed in the survey specification that were not located during the survey, and offer opinions as to why they were not found.

I.3 Charted wrecks, obstructions or other dangerous features, which have not been located and examined during a survey must be disproved if at all possible. They are unlikely be removed from the chart without a positive statement from the Surveyor that this is justified.

I.4 Whatever the outcome of the search, whether as part of a larger survey or as an individual examinations, the Surveyor must report the findings in full, in an appropriate manner, and with supporting traces as necessary, together with a positive recommendation as to future charting action.

I.5 For any 'not fully surveyed' (NFS) wrecks, a brief statement of the additional work required, e.g. 'to be wire swept'.

I.6 List all seabed obstructions (including wellheads**)** located, as well as those which were not found (and why).

I.7 List all fisherman's fasteners, stating whether any have been searched for and found, and whether correlation is possible with other features. Any information obtained in confidence is to be identified.

ANNEX J TO
[Report of Survey Reference]
[Date]

Tidal Stream Observations

J.1 Include Record of Tidal Stream/Current Observations.

ANNEX K TO
[Report of Survey Reference]
[Date]

Light Sectors and Buoys

K.1 Give details of how all light sectors were observed, and list the final accepted sectors. Check these against Annex P (Amendments to Light List).

K.2 List all buoys by name, number (where appropriate), characteristics and position (mean of flood and ebb fixes).

ANNEX L TO
[Report of Survey Reference]
[Date]

Seabed Textures, Natures of the Bottom and Retained Seabed Samples

L.1 Give a general description of the nature and texture of the seabed, draw attention to any special features found and state the extent and direction of any areas of sand ripples.

L.2 List position, height, extent and assessment of any contacts with a dimension of > 1 m.

L.3 Provide a Record of Seabed Samples and Cores.

ANNEX M TO
[Report of Survey Reference]
[Date]

Topographical Features, Conspicuous Objects and Marks

M.1 List all topographical features currently charted or mentioned in the Sailing Directions as conspicuous or prominent by name, position and relevant paragraph in Sailing Directions with comment on whether conspicuous or prominent.

M.2 Provide a separate list of features considered conspicuous or prominent but not formerly charted as such.

M.3 The lists should include photographs and not be confined to features within, or visible from the survey area but should include features nearby that have been assessed when on passage to and from the replenishment port**.**

M.4 Provide full details of measured distances either found, or charted but no longer usable.

M.5 Provide full details of all marks used to indicate clearing lines, leading lines and recommended tracks either found, or charted but no longer usable.

ANNEX N TO
[Report of Survey Reference]
[Date]

Sailing Directions Amendments and Nomenclature

N.1 During the course of any survey, the relevant Sailing Directions should be carefully examined and suitable amendments formulated. Notes for these amendments must be kept throughout the survey, as the need for them is realised, and the revised text should be compiled immediately after the completion of work in the field, when every essential point is still fresh in the mind. It is not possible to write Sailing Directions solely from study of the bathymetric sheet.

N.2 The annex should clearly indicate which paragraphs of Sailing Directions have been verified.

N.3 Sailing Directions are written by the surveyor as information supplementary to the bathymetric sheet, but should be applicable, if possible, to the existing published chart as well. It should be borne in mind that the editors of Sailing Directions do not normally see the bathymetric sheet and will use the published chart when examining the surveyor's proposed text. Consequently reference objects should, whenever possible, be common both to chart and bathymetric sheet.

N.4 As a general rule, the Sailing Directions applicable to a survey will be covered by only a few pages in the published book, but care must be taken to check the general information in the appropriate volume as well as that in any of the appendices which may be relevant to the area being surveyed or to adjacent localities.

N.5 In each case, the position of the amendment should be clearly identified. When writing large amendments, it is recommended that these should be compiled in the style of the book being amended. The surveyor should always be prepared to be more expansive in his text than is likely to be necessary for the published book. The editor will then be able to get a fuller picture of the area and will be able to condense, or précis, the proposed amendments with more authority. It is particularly important that if any detail is to be deleted from a large section being rewritten, a positive statement to the effect, with background detail if appropriate, should be included. Merely omitting a point leaves the editor in doubt as to whether the omission is deliberate or an oversight.

N.6 Whenever possible, any structure specifically mentioned in Sailing Directions should be illustrated by colour photographs, and general views (colour photography or manuscript) provided wherever these would be useful. These are especially valuable in the approaches to ports, and along recommended leading lines.

N.7 In particular the following features should be described or reported:

Anchorages	If extensive or complicated, they should be included on a tracing accompanying the bathymetric sheet.
Berths	To be fully described
Breakers	Details of areas of breakers and inhospitable coasts are to be given.

Bridges	To be fully described. Where a bridge moves to allow shipping to pass the width of the channel formed is to be reported.
Clearing Lines	To be fully described, mentioning (if a transit) the rear mark first and then the front mark.
Cliffs	Where their colour is significantly different from the surroundings, and this fact would be useful to the mariner, it is to be reported.
Danger Areas	If extensive or complicated, they should be included on a tracing accompanying the bathymetric sheet.
Dolphins	To be fully described
Eddies	Comment as to whether the feature is dangerous or not.
Ferries	To be fully described
Floating Bridges	To be fully described
Fresh water Springs	To be fully described
Groynes	To be fully described
Harbour Facilities	To be fully described. To avoid unnecessarily long descriptions of large ports it will often suffice if copies of the port brochures and regulations are obtained and forwarded with the Amendments to the Sailing Directions.
Jetties	To be fully described
Kelp	Areas of kelp, its existence and extent of its effect are to be fully described
Leading Lines	To be fully described, mentioning (if a transit) the rear mark first and then the front mark.
Light Sectors	If sectors are different from those already charted, details are to be given.
Locks	To be fully described. The maximum depth over the sill is to be reported
Measured Distances	To be fully described.
Offshore Installations	To be fully described
Outfalls	To be fully described
Overfalls	Comment as to whether the feature is dangerous or not.

Overhead Lines	Where they pass over a navigable channel, the safe clearance above MHWS (or MHHW) is to be reported together with the names of the authority responsible and their contact officer. Some overhead lines are conspicuous to radar and may appear as a contact on a steady bearing. When this is the case, the effect should be described.
Port Facilities	To be fully described. To avoid unnecessarily long descriptions of large ports it will often suffice if copies of the port brochures and regulations are obtained and forwarded with the Amendments to the Sailing Directions.
Recommended Tracks	To be fully described, mentioning (if a transit) the rear mark first and then the front mark.
River bar	If the bar is liable to change, the fact is to be stated.
Sandwaves	Limits, orientation, distance between crests, and maximum height from trough to crest are to be given.
Sewers	To be fully described
Slipways	To be fully described
Spoil Grounds	To be fully described.
Tide-rips	Comment as to whether the feature is dangerous or not.
Well-heads	To be fully described
Wharves	To be fully described

N.8 Give the Surveyor's recommendations for pilotage through the survey area (if appropriate).

N.9 All charted names should be checked. If a name different from that charted is found to be in general use locally the authoritative source of the information is to be reported. List separately any new names proposed, with full explanation of the reasoning behind the need to name the feature (except in unexplored areas when this is self-evident) and the selection of the proposed names.

N.10 Any local mapping obtained should be forwarded with the Report of Survey and identified in this annex.

ANNEX O TO
[Report of Survey Reference]
[Date]

Views

O.1 There is a continuing need for photographs to illustrate Sailing Directions. In general photographs over 10 years old are not reliable, therefore every opportunity should be taken to re-photograph existing views, and provide new views.

O.2 The compiler of a chart and the editor of Sailing Directions can be greatly helped if they can visualise the area with which they are dealing. One of the best ways of providing this visual input is by the use of photographic views. Good quality colour photographs, particularly aerial obliques, are preferred.

O.3 The surveyor should take steps to illustrate the Report of Survey and the Amendments to the Sailing Directions as fully as possible. Even if only a few of the pictures forwarded are eventually published, they will all have been examined in the Hydrographic Office and will have allowed those processing the survey to see the area, in part at least, as the mariner sees it.

ANNEX P TO
[Report of Survey Reference]
[Date]

Light List Amendments

P.1 List all discrepancies found between the detail shown in the relevant Light List and published charts and those observed.

ANNEX Q TO
[Report of Survey Reference]
[Date]

Radio Signals Amendments

Q.1 List amendments for the appropriate list of Radio Signals covering the survey area and ports visited. Describe details of vessel traffic services, ship reporting systems, maritime safety information broadcasts, radio pilot services, port operations, radio navigational aids, radio and radar beacons, coast radio station services and search and rescue procedures.

ANNEX R TO
[Report of Survey Reference]
[Date]

Ancillary/Miscellaneous Observations

R.1 Provide details in the form required by the survey specification or, if not mentioned therein, in as clear and concise a format as possible (preferably tabular). Include in this Annex; corrections to the Air Photographic Plot, Spoil Grounds and Dredged Areas, Freshwater Springs, and details of any Oceanographic or Geophysical Observations undertaken.

ANNEX S TO
[Report of Survey Reference]
[Date]

Reports of Dangers and Hydrographic Notes

S.1 List all signalled, faxed or e-mail reports and refer to Forms H102 and H102A submitted in respect of the area surveyed.

ANNEX T TO
[Report of Survey Reference]
[Date]

Personnel

T.1 Provide a nominal list, with relevant dates, of all involved with the survey.

ANNEX U TO
[Report of Survey Reference]
[Date]

Diary of Notable Events

U.1 List all significant events (with their dates) which have influenced the conduct of the survey. These may include:

a. Establishing control;
b. Survey navaid calibrations;
c. Start of fieldwork;
d. Port calls and leave periods;
e. Sea Training, Naval Exercises or other military activities;
f. Serious breakdowns (ship or equipment);
g. Completion of fieldwork;
h. Post-survey navaid calibrations.

ANNEX V TO
[Report of Survey Reference]
[Date]

Summary of Surveying Activity

V.1 It is often useful to provide a table giving the breakdown of the days covering the period of the survey (between the dates quoted on the front cover of the Report of Survey). 'Downtime' is calculated in days derived from aggregated hourly periods. Harbour days should be entered in the column that represents the primary activity for each day. The sum of the individual columns should equal the total shown in the first column. Column headings are as follows:

TOTAL	**SEA**				**Harbour**		
		Days Lost					
Calendar Days	Surveying	Weather, Ship and Equipment Downtime	Passage	Military Duties	Maintenance and Emergency Repair	Leave	Visits including logistic stops