TECHNICAL SPECIFICATION

NAVIGATIONAL AIDS FOR OFFSHORE STRUCTURES

DEP 33.80.00.30-Gen.

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DESIGN AND ENGINEERING PRACTICE

USED BY

COMPANIES OF THE ROYAL DUTCH/SHELL GROUP

PREFACE

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NOTE: In addition to DEP publications there are Standard Specifications and Draft DEPs for Development (DDDs). DDDs generally introduce new procedures or techniques that will probably need updating as further experience develops during their use. The above requirements for distribution and use of DEPs are also applicable to Standard Specifications and DDDs. Standard Specifications and DDDs will gradually be replaced by DEPs.

TABLE OF CONTENTS

APPENDICES

1. INTRODUCTION

1.1 SCOPE

This DEP gives the minimum requirements for the design and manufacture of audible and visual navigational aids systems for permanent use on offshore fixed structures. The extent of equipment supplied against this specification includes all lights, sound signals, power supply equipment and associated fittings necessary to comply with the latest revisions of all relevant standards and regulations.

Where national requirements exist for navigational aid signal characteristics, these shall take precedence. The light and sound signal characteristics requirements for some countries are summarised in Appendix 1.

Temporary navigational aids, equipment associated with platform or structure identification, and navigational aids designs for structures which are specially established as aids to navigation, are excluded from the scope of this DEP.

Information relating to a specific installation should be given in the Data/Requistion DEP 33.80.00.94-Gen.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIPM, the distribution of this DEP is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company, and to Contractors and Manufacturers/Suppliers nominated by them (i.e. the distribution code is "F" as described in DEP 00.00.05.05-Gen).

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

In the case of conflict between documents the following hierarchy shall apply:

upper level: purchase order and variations thereto

second level: requisition sheet and project specification

third level: this specification.

1.3 DEFINITIONS

1.3.1 General Definitions

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

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

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **Shall** indicates a requirement.

The word **Should** indicates a recommendation.

1.3.2 Specific Definitions

availability - Availability is defined as

$$\frac{MTBF}{MTBF + MTTR}$$

back-up time - The back-up time of a battery is the duration for which the battery can supply its rated load within its specified voltage limits.

certificate - Document issued by a recognised authority certifying that it has examined a certain type of apparatus and, if necessary, has tested it and concluded that the apparatus complies with the relevant standard for such apparatus.

certificate of conformity - Certificate stating that the electrical apparatus complies with the relevant standards for apparatus for potentially explosive atmospheres.

charge factor - The ratio between the quantity of charge supplied to the battery and the quantity of charge taken from the battery on a daily basis.

daily depth of discharge - The quantity of charge taken from the battery on a daily basis, expressed as a percentage of the nominal capacity of the battery.

declaration of compliance - Document issued by the Manufacturer declaring that the electrical apparatus complies with the requirements of IEC 79-15.

effective intensity - The effective intensity of rhythmic lights shall be calculated in accordance with the IALA "Recommendations for the calculation of the effective intensity of a rhythmic light", using the Schmidt-Clausen method of calculation, where this is applicable for the apparatus concerned.

expected lifetime - The expected lifetime of the Navigational Aids System is the time during which the navigational aids system remains suitable for the application for which it was made, provided it is used, regularly inspected, examined and serviced in accordance with the Manufacturer's instructions and with replacement of parts subject to mechanical wear.

foot : 0.3048 m

hazardous area, 426-03-01, IEC 50 - An area in which an explosive gas atmosphere is or may be expected to be present in quantities such as to require special precautions for the construction, installation and use of electrical apparatus.

insolation - see irradiation.

irradiance - Radiant power incident upon a unit area of surface (Wm^{-2}).

irradiation - Integration of irradiance over a specified period of time (MJm^{-2} per hour, day, week, month, year as the case may be).

marking - Data put on the electrical apparatus by the Manufacturer giving information for safe use of the apparatus.

mean time between failure - MTBF: Mean time between failure is defined as:

$$\frac{\text{operating time (hours)}}{\text{number of faults that have resulted in outages}}$$

mean time to repair - MTTR:

$$\frac{\text{time to repair and to return to service (hours)}}{\text{number of faults that have resulted in outages}}$$

Note: The above MTBF and MTTR definitions are based on statistics and are valid only under the following conditions:

- at least one period of 4 years continuous operation of at least 4 pieces of similar equipment but excluding the first 3 months of initial operation of the Navigational Aids System
- only considering the time to repair the Navigational Aids System

- in the MTTR a maintenance overhaul time of 80 hours over a 2 weeks period after 4 years of operation shall be included
- operation of the Navigational Aids System in accordance with the Manufacturer's instructions assuming qualified men and materials are available at the work site

nautical mile : 1852 m

nominal value, 151-04-01, IEC 50 - A suitable approximate quantity value used to designate or identify a component, device or equipment.

offshore installation - An installation located near open saliferous water, e.g. platforms, jetties, floating drilling/production facilities.

rated value, 151-04-03, IEC 50 - A quantity value assigned, generally by the manufacturer, for a specific operating condition of a component, device or equipment.

reliability - Reliability is defined as the exponential function:

$$e^{x}, \text{ where } x = \frac{-8760}{MTBF}$$

requisition - means data/requisition DEP 33.80.00.94-Gen.

spectral response curve - The short-circuit current density generated by unit irradiance at a particular wave length (AW^{-1}), plotted as a function of wave length.

standard test conditions - The standard test conditions are:
(1) Cell temperature: 25 ± 2 °C.
(2) Irradiance, as measured with a reference device: 1000 Wm^{-2} with the reference solar spectral irradiance distribution.
(3) Air mass: 1.5, representing the sun at 45°.

state of charge - The quantity of charge present in a battery, expressed as percentage of the nominal capacity of the battery.

test report - Document prepared by the Manufacturer indicating in detail the tests and verifications to which the electrical apparatus has been subjected and their results.

vital service - A service which, when failing in operation or when failing if called upon, can cause an unsafe condition of the process and/or electrical installation, jeopardize life, or cause major damage to the installation.

usual range - The usual range of a sound signal shall be calculated in accordance with the IALA "Recommendations for the calculation of the range of a sound signal" and the IALA Report "The definition and method of calculation of the nominal range and the usual range of a sound signal".

zone 1 (in the classification of hazardous gas areas), 426-03-04, IEC 50 - An area in which an explosive gas atmosphere is likely to occur in normal operation.

zone 2 (in the classification of hazardous gas areas), 426-03-05, IEC 50 - An area in which an explosive gas atmosphere is not likely to occur in normal operation and if it does occur will exist for a short period only.

1.4 ABBREVIATIONS

AISI	:	American Iron and Steel Institute
BS	:	British Standard
cd	:	Candela
DDOD	:	Daily Depth of Discharge
HRC	:	High Rupturing Capacity
IP	:	Enclosure degree of protection according to IEC 529
IALA	:	International Association of Lighthouse Authorities
ICAO	:	International Civil Aviation Organisation
IEC	:	International Electrotechnical Commission
ISO	:	International Organisation for Standardization
LED	:	Light emitting diode
MHWS	:	Mean High Water Springs
NCCP	:	Navigational aids central control panel
racon	:	radar beacon
SI	:	International System of Units
VDE	:	Verband Deutscher Elektrotechniker

1.5 VARIOUS

Technical units, quantities etc. are and shall be expressed, used and abbreviated according to the SI system as far as practicable.

1.6 CROSS REFERENCES

Where cross references to other parts of this DEP are made, the referenced section number is shown in brackets. All standards referenced in this DEP are listed in (8).

2. BASIC REQUIREMENTS

2.1 GENERAL

The navigational aids system shall be suitable for continuous operation at full load within the specified service conditions. Special requirements shall be stated in the requisition.

The navigational aids units shall be the product of a company regularly engaged in their manufacture.

All materials and parts included in the construction of the navigational aids or of their related or auxiliary equipment shall be new and unused, and of current manufacture.

The navigational aids system shall be designed for an expected lifetime of:

- 10 years for valve regulated battery cells.
- 20 years for vented battery cells
- 20 years for all other navigational aids units.

Note: It is recognised that the specified expected lifetime cannot be achieved for some individual components (e.g. lamps). The specified lifetime of the assembly shall be met by means of scheduled maintenance programmes.

The navigational aids system shall have a minimum Availability of 0.998 and a minimum Reliability of 0.84.

In addition to the requirements stated in the requisition, the following drawings may be supplied to the Manufacturer:

- a layout drawing showing the proposed location of the individual equipment items such as lanterns, sound signals, aeronautical obstruction lights
- a helideck layout showing the outlines and configuration of the helideck and the obstacle free zones
- a block diagram indicating the main and alternative power supply units and the basic control, alarm and trip functions.

2.2 SAFETY

The navigational aids system shall be designed to minimize any risk of short circuits and to ensure personnel and operational safety under all conditions of operation, inspection and maintenance.

Components shall be capable of withstanding the thermal and dynamic stresses resulting from internal and external short circuits and circuit switching operations, etc. Damage arising from component failure should be confined to the component concerned.

Component materials shall be non-flame propagating.

Electrolytes, e.g. for capacitors, shall be non-toxic and totally free from polychlorinated biphenyls (PCB's).

2.3 SERVICE CONDITIONS

The equipment shall in all respects be suitable for operation in service conditions typically found on offshore structures.

Unless otherwise specified, the following conditions shall apply:

2.3.1 Site Conditions

The conditions pertaining to the location where the equipment is to be installed shall be specified in the requisition.

2.3.2 Location

The control panel and battery shall be located in a closed ventilated building unless otherwise specified in the requisition. All other equipment shall be located outdoors in the open air.

Note: Batteries may require closer temperature tolerances than those given in the requisition. The Manufacturer's instructions shall be followed.

2.3.3 Area Classification

The equipment and all its accessories shall be suitable for the area classification as specified in the requisition. For the additional requirements for navigational aids units in hazardous areas see (5).

2.3.4 Altitude

The equipment and all its accessories shall be suitable for altitudes up to 200 m.

2.3.5 Electricity Supply System

The AC supply to the navigational aids control panel shall be single-phase or symmetrical three-phase with a nominal voltage and frequency as indicated in the requisition. The waveform of the input voltage, with the navigational aids system disconnected, will be sinusoidal (as defined by IEC 146). The input supply variations shall be limited under steady state conditions to:

- nominal system voltage : plus 10% and minus 10%
- nominal system frequency : plus 5% and minus 5%

In addition to the above variations, the input voltage may be subject to transients comprising voltage depressions up to 20% of the nominal voltage during motor starting and to voltage interruptions during system short circuits. Transient high-frequency voltages of up to 2 kV peak may also be superimposed on the input voltage as a consequence of system switching operations, etc.

The requisition will state the method of neutral earthing of the incoming AC supply to enable the Manufacturer to select the proper insulation level.

The battery backed-up DC supply to the sound signal and light control panel shall be floating and equipped with a sensitive earth fault monitoring system.

2.4 DESCRIPTION OF THE NAVIGATIONAL AIDS SYSTEM

The navigational aids system for offshore installations shall comprise:

- visual navigational aids
- audible navigational aids
- power supply units

The navigational aids system shall comply with the IALA publication "Recommendations for the Marking of Offshore Structures".

The navigational aids system may include the following additional equipment, as specified in the requisition:

- electrical outfitting to allow helicopter landing operations (landing and take-off area lighting systems and aeronautical obstruction lights);
- electrical equipment to identify a particular structure on a shipping route (racons).

The navigational aids shall be purchased as integral packages complete with all wiring between those panels which are mounted on a common frame. Provision shall be made to accept interconnecting cables which will be provided by others.

The Manufacturer shall obtain type approval for an individual navigational light or sound signal from the relevant local Authorities. The Principal is responsible for obtaining relevant approval for the system design and the proposed location of the navigational aids; the Manufacturer shall assist with the latter on request.

2.4.1 Visual Navigational Aids

The visual navigational aids system may include the following units:

- One or more main lights. If more than one main light is required they shall operate in

unison.
- One or more secondary lights with an intensity less than the main lights. The secondary lights shall automatically come into operation upon failure of the main lights.
- One or more subsidiary lights which mark the horizontal extremities of the structure, if not covered by the main and secondary lights specified above.

The lights shall be arranged such that the main and subsidiary lights provide the normal marking. In the event of the main light failing (whether due to a fault or a mains power failure) the secondary light shall take over its duty. The subsidiary lights shall be unaffected by failure of the main lights.

The main and secondary lights (if required) shall be located in the same place. A combined single-lift unit is preferred.

The main, secondary and subsidiary lights may be either:

- powered and controlled from the NCCP with integrated inverters, coders, code monitors, status and alarm annunciators and sub-distribution equipment, or
- powered from the NCCP complete with integrated status and alarm annunciators The coders, code monitors and synchronizing facilities shall be decentralised at the lights.

Note: See (3.1.2) for power and coding requirements for main lights.

2.4.2 Audible Navigational Aids

One omni-directional type sound signal may be used for relatively small structures where sound propagation is unimpeded in all directions.

Two directional type sound signals may be used for relatively large structures or bridge-connected platform configurations.

The main and secondary sound signals shall be located in the same place. A combined single-lift unit is preferred.

The sound signals may be either:

- powered and controlled from the NCCP with integrated inverters, coders, code monitors, status and alarm annunciators and sub distribution equipment, or
- powered from the NCCP complete with integrated status and alarm annunciators. The coders, code monitors and synchronizing facilities shall be decentralised at the sound signals.

The requisition will state if a visibility detector for automatic start/stop of the sound signals is required, see (3.2.2).

2.4.3 Power Supplies

The power supplies shall consist of:

- a normal AC power supply, without battery back-up, for main lights with 12000 cd effective intensity.
- a battery backed-up standby power supply for vital services such as main lights (if of 1400 cd effective intensity), sound signals, secondary lights, subsidiary lights and associated controls.

The standby power supply system shall be dedicated to navigational aids consumers and should be assembled as part of the NCCP.

The specification for solar voltaic power supply systems is given in Appendix 2. The project requirements shall be stated in the requisition.

2.5 INFORMATION TO BE SUBMITTED WITH THE TENDER

The Manufacturer shall submit a technical specification of the navigational aids units which shall include a description of the design, operation, construction, performance and maintenance aspects of the equipment.

The information shall include relevant calculations of the nominal battery capacity and the number of battery cells that are needed to meet the specified performance requirements of

the navigational aids system.

The Manufacturer shall include relevant information about recommended interconnecting cables between NCCP (if applicable) and the sound signals and lights. The information shall include the voltage and current of the lights and sound signals, recommended cable sizes, and number of cores per cable.

The Manufacturer shall submit the information requested on the requisition for navigational aids, DEP 33.80.00.94-Gen. and the requisition for DC UPS unit, DEP 33.65.50.93-Gen., by completing the documents and returning them with the tender.

The Manufacturer shall state in the requisition the country and town of origin of the main parts.

For maintenance back-up at site the Manufacturer shall indicate the nearest service organisation for the location at which the system will be installed.

The Manufacturer shall confirm in writing that the navigational aids system fully complies with this specification and the requisitions, or shall provide a detailed listing of proposed deviations.

The Manufacturer shall submit copies of the light intensity and sound pressure test reports of all quoted lights and sound signals, issued by an independent authority.

The Manufacturer shall submit availability and reliability calculations, including the assumptions used in the calculations.

3. PERFORMANCE REQUIREMENTS

3.1 LIGHTS

3.1.1 General

The light beam axis shall be directed so that it is not elevated above the horizontal or depressed below the horizon. The total beam width in the vertical plane shall not be less than 2.5 degrees at the points on the curve of intensity distribution where the intensity is 10% of the maximum.

The following shall apply to lights fitted with an automatic lamp changer:

- The lamp changer shall be equipped with six lamps
- The lamp changer shall automatically place a healthy lamp at the focal centre of the lens when the original lamp has failed. When all six lamps have failed, the lamp changer shall cease turning to prevent damage to the lamp changer and to enable the detection of lamp failure.

3.1.2 Main Lights

Main lights shall provide white signals with an effective intensity as specified in the requisition, taking all losses into account.

Main lights with an effective intensity of 12000 cd shall be supplied directly from the platform main power supply, with coders, code monitors and synchronization facilities installed in the NCCP.

Main lights with an effective intensity of 1400 cd should be controlled by inverters, coders, code monitors and synchronization facilities located in the NCCP. They shall be fitted with automatic lamp changers.

Main lights may be equipped with integrated solid state coders with synchronization facilities to the other main lights, if agreed by the Principal.

3.1.3 Secondary and Subsidiary Lights

Secondary lights shall be synchronized with the main lights.

Secondary and subsidiary lights shall be fitted with automatic lamp changers.

3.2 SOUND SIGNALS

3.2.1 General

Main sound signals and secondary sound signals (if required) may be of the directional or omnidirectional type. The sound signal system shall always provide a 360 degree coverage in the horizontal plane around the structure.

When more than one sound signal is provided on a structure, due consideration shall be given to the possible effects of sound cancellation. The Manufacturer shall recommend facilities to prevent this. The facilities may consist of one or more of the following:

- strategic location of the signals on the structure
- the use of sound baffles
- a frequency difference of a minimum of 10 Hz between any pair of sound signals

Consideration shall be given to unacceptable sound pressure levels experienced within the confines of the installation due to the operation of the sound signals. Sound baffles may be used provided it can be demonstrated that they will not cause sound cancellation by reflection.

3.2.2 Visibility Detector

If the requisition specifies a visibility detector, it shall automatically start or stop the sound signals when visibility has decreased below or increased above two nautical miles.

The visibility detector shall be designed for unattended operation. Its operation shall not be influenced to an unacceptable level by dust or salt deposits or condensation on the lenses.

The visibility detector shall comply with the following:

Operation	:	Measurement of back-scattered light
Sender	:	Pulsed Light Projector
Receiver	:	Photo Sensitive Receiver
Visibility Threshold	:	2 nautical miles
Light Source	:	Xenon low intensity flash lamp
Spectral Range	:	Ultra Violet
Measuring Scale	:	Adjustable 0.1 to 10 nautical miles
Sampling Zone	:	Between 3 and 30 m in front of the instrument

The final position and orientation of the visibility detector shall be advised by the Manufacturer.

3.3 CONTROL OF THE NAVIGATIONAL AIDS SYSTEM

3.3.1 Overall System Control and Monitoring

The navigational lights and sound signals shall be controlled and monitored from the NCCP, which shall provide as a minimum:

- manual on/off control of lights and sound signals
- switches to enable/disable automatic control of lights and sound signals
- voltage-free contacts for transmission of status and alarm signals to a remote location, if specified on the data/requisition sheet
- facilities to accept remote control signals, if specified on the data/requisition sheet
- power distribution to the lights and sound signals.

Wherever possible the control equipment shall be solid state type. All indicator lamps shall be LED type.

Contact ratings of status and alarm contacts shall be:

Minimum Making Capacities

1.6A at 500 V	AC and power factor 0.3
1.7A at 110 V	DC inductive
4A at 60 V	DC inductive

Minimum Thermal-breaking Capacities

1A at 500 V	AC and power factor 0.3
1A at 110 V	DC inductive
2A at 60 V	DC inductive

3.3.2 Control of Lights

Control of the lights shall be fully automatic.

The primary control shall be by a photocell provided by the Manufacturer. In addition, an override switch for the NCCP mounted photocell and facilities for remote start/stop are required.

Under normal operating conditions the main and subsidiary lights shall be illuminated. For systems provided with main and secondary lights, failure of a main light shall automatically cause the associated secondary light to be illuminated.

As a minimum, the NCCP shall be equipped with the following:

- two DC/AC inverters (one main and one standby) for supply to the main lights (if 1400

cd), the secondary lights and the subsidiary lights
- two "U" coders controlling all the lights, one main and one standby
- one central "U" code monitor for the light system, initiating the automatic transfer of the coders
- one current monitor for the main lights
- one current monitor for the secondary lights (if installed)
- one current monitor for the subsidiary lights (if installed)
- indicators for:
  . inverter failure
  . main lights in operation (common)
  . secondary lights (if installed) in operation (common)
  . subsidiary lights (if installed) in operation (common)
  . main lights failure (common)
  . secondary lights (if installed) failure (common)
  . subsidiary lights (if installed) failure (common)
  . "U" coder failure
  . power "on"
- indicator test pushbutton
- reset pushbutton

3.3.3 Control of Sound Signals

Starting and stopping the sound signals shall be a manual action, either local or remote. If specified in the requisition, the Manufacturer shall provide a visibility detector to also allow automatic start/stop control, see (3.2.2). Once started, the sound signal operation shall be automatic.

Under normal operating conditions the main sound signals shall emit where main and secondary sound signals are installed. If the output from a main sound signal, as detected by an emitter current monitor, falls below the nominal 2.0 nautical miles range, the system shall automatically transfer to the secondary sound signals and initiate an alarm.

As a minimum, the NCCP shall be equipped with the following:

- two DC/AC inverters (one main and one standby) for supply to the main and secondary sound signals
- two "U" coders controlling all the sound signals, one main and one standby
- one central "U" code monitor for the sound signal system initiating the automatic transfer of the coders
- one current monitor for the main sound signals
- one current monitor for the secondary sound signals (if installed)
- indicators for:
  . inverter failure
  . main sound signals in operation (common)
  . secondary sound signals (if installed) in operation (common)
  . main sound signals failure (common)
  . secondary sound signals (if installed) failure (common)
  . "U" coder failure
  . visibility detector failure
  . power "on"
- indicator test pushbutton (may be combined with 3.3.2)
- reset pushbutton (may be combined with 3.3.2).

Note: The purpose of the inverters of (3.3.2) and (3.3.3) is to increase the voltage to the lights and sound signals, in order to reduce the cable voltage drops.

3.4 POWER SUPPLIES

The standby power supply unit shall comprise a single rectifier/battery set providing 24V DC floating, unless otherwise stated in the requisition. The constant voltage/current limiting static type rectifier, auxiliary equipment and battery set shall comply with DEP 33.65.50.31-Gen. The required battery back-up time differs for the various countries, see Appendix 1, and shall be stated in the requisition. The rating of the rectifier shall allow for operation of the navigational aids system with the batteries disconnected.

The battery capacity shall be calculated by the Manufacturer, who shall provide the detailed calculations to the Principal.

3.5 RADIO FREQUENCY INTERFERENCE LIMITS

The production of radio frequency interference voltages shall not exceed the value of suppression grade "N", as defined in VDE 0875.

Radio frequencies emitted by other equipment according to class G emission levels shall not interfere with the correct operation of the navigational aids system. The performance of the navigational aids system shall not be affected or in any way degraded by the use of portable radio transmitters.

4. CONSTRUCTION REQUIREMENTS

4.1 MATERIALS

All components shall be suitably protected for operation in a tropical climate, and they shall be moisture and fungus proof.

All exposed hardware, hinges, etc. shall be AISI 316 L stainless steel.

4.1.1 Lights

Main lights with an effective intensity of 12000 cd shall be equipped with a heat resistant glass lens, and they shall have facilities for mounting a secondary light on top. Main lights with an effective intensity of 1400 cd, secondary lights and subsidiary lights shall be fitted with polycarbonate fresnel lenses and anti-bird spikes. Lens colour of the lights shall be as specified in Appendix 1.

In order to minimise the influence of the saliferous atmosphere and the accumulation of dirt inside the lights, all lights shall be totally sealed and have natural cooling.

4.1.2 Sound Signals

Sound Signals shall be equipped with AISI 316 L stainless steel diaphragms with moulded moving coils.

When specified in the requisition, directional sound signals shall be fitted with 240 degree sound baffles and support frames in AISI 316 L stainless steel.

4.2 UNIT ENCLOSURES AND ACCESSIBILITY

The rectifier and the NCCP monitoring sections in industrial execution shall be installed together in a free standing, self-supporting sheet steel enclosure. The enclosure shall be suitable for operation and maintenance with its rear panel against a wall and with similar units located immediately on both sides.

Note : For the NCCP installed in a hazardous area, see (5).

The floor of the building or location where the enclosure is installed shall not be considered as forming part of the enclosure. Internal cooling shall be by natural ventilation. The temperature of internal components shall not have a detrimental effect on any other components within the NCCP.

Equipment and components located within the enclosure shall not be mounted directly on the walls of the enclosure. The location and grouping of components and auxiliary equipment shall permit easy identification and access for operational, maintenance and repair purposes. Suitable partitioning between the rectifier section, light control/monitor section and sound signal control/monitor section, and between individual items shall be provided where necessary to allow adjustment and inspection to be carried out safely. The electronic control and protection system shall be of modular design and equipped with function fault indicators.

To prevent inadvertent contact by personnel when the cabinet door is open, all live terminals of door-mounted equipment having a maximum voltage greater than 24 V DC shall be shrouded or otherwise protected by barriers to a degree of protection of at least IP 30. Barriers shall be of rigid transparent insulating material to enable the screened components to be identified. Protection relays which can cause tripping of the unit shall not be installed on a door.

To prevent inadvertent contact or short circuit by personnel when performing control circuit adjustments or when resetting/replacing protective devices, all bare busbars and live terminals of equipment and components located within the enclosure shall be similarly protected by barriers or shrouds to a degree of protection of at least IP 20, unless adequately recessed within the enclosure.

4.3 ENCLOSURES DEGREE OF PROTECTION

The minimum enclosure degree of ingress protection, in accordance with IEC 529, shall be:

- IP 41 for equipment installed indoors
- IP 65 for equipment installed outdoors, outside deluge areas
- IP 66 for equipment installed outdoors, in deluge areas
- IP 23 for battery sets installed outdoors.

Note : The enclosure protection of outdoor battery sets is determined by ventilation requirements.

4.4 COMPONENT REQUIREMENTS

Printed circuit boards shall include visual LED status indication and test connections to facilitate fault diagnosis.

Main mechanical circuit switches shall comply with IEC 947-3 and be of the independent manually operated air-break type for continuous duty. They shall comply with utilisation category AC-23A and DC-23A for AC and DC switches respectively. Main circuit switches shall have padlocking facilities in the off position.

Contactors shall comply with IEC 947-4-1 and be rated for uninterrupted duty and intermittent duty of at least class 0.1. The utilisation category for DC contactors shall be not less than DC-5 and for AC contactors not less than AC-3.

Transformers and reactors shall be of the air-cooled type and shall comply with IEC 146-1-3.

Fuses in power circuits shall be of the HRC type with a minimum short circuit interruption capacity of 100 kA rms. Fuses in control circuits shall have a short circuit interruption capacity compatible with the peak let through current of the upstream power circuit protection device.

Fuses shall be mounted in such a way that safe and easy replacement of fuses in one circuit can be done without disturbing other circuits. Diazed fuses shall have facilities to prevent loosening of cups due to vibration.

Miniature circuit breakers and moulded case circuit breakers, if used, shall comply with IEC 947-2 and shall fulfil the requirements of Category "B".

4.5 INTERNAL WIRING AND TERMINATIONS

For secondary wiring, single core stranded copper conductors with non flame propagating insulation materials shall be used. The size and type shall be selected on current carrying capacity, voltage and mechanical strength.

Wiring between terminals shall be continuous and without joints. Wiring shall not be directly fixed to metal parts.

Wires shall be held in position by means of insulated tubes, channels, cleats or plastic strips and shall be routed such as to avoid mechanical damage. Channels, tubes, etc. shall not be filled to more than 75% total capacity during manufacture. Wiring between fixed portions and hinged doors shall in addition to the electrical insulation be protected from abrasion or entrapment and shall not be carried over or bent around sharp edges, etc.

Individual wires or cables terminating at fixed (not plug-in) components shall be identified by means of ferrules of insulating material marked in accordance with the Manufacturer's drawings. Wrap around, adhesive type markers shall not be used.

Individual terminals for all conductors shall be provided unless the terminal is designed to accept more than one conductor. Terminals shall be constructed in such a way that direct contact between screws, bolts or nuts and the conductors is avoided. Partitions shall be placed between terminals of different voltages. Stranded wiring ends which have to be connected into butt type contacts and terminals shall be provided with compression type pre-insulated wire pins with insulation support.

Terminals shall be of the non-loosening type. Terminals to accommodate wiring supplied by others shall be sized to accept minimum 4 mm^2 wires.

A minimum of 25% spare control terminals shall be provided in each panel.

4.6 EXTERNAL CABLE TERMINATIONS

All panels and enclosures shall have facilities for the entry of cables from the top or bottom, as specified in the requisition.

The minimum terminal size for low-voltage power wiring shall be 4 mm^2 copper.

Control cable connections shall be accessible from the front of the enclosures.

The Manufacturer shall supply all connection material, cable supports and clamping within the panels and enclosures. These shall be suitable for the size and the number of conductors installed.

Interconnecting cables between remotely located equipment will be supplied and installed by others.

A row of terminals shall be installed within each panel or enclosure for the termination of all outgoing cables. This terminal row shall be separate from other internal components and located near the cable entry. Adequate space for terminating the external cables shall be provided.

All compartments with outgoing cables shall be provided with fully gasketed and removable gland plates for cable gland termination. A minimum of 25% spare entries shall be provided.

The Manufacturer shall include compression-type cable glands suitable for the cables as specified on the requisition.

4.7 EARTHING

Where a number of electrical components are to be earthed parallel earthing shall be employed and not the series looping of equipment.

An earth rail with a suitable number of earthing bolts or screws shall be provided in a position close to the external cable glands to facilitate termination of cable earth braids or armouring. Individual connections for all earth wires shall also be provided.

A threaded brass earth stud of not less than 6 mm diameter with nuts and spring washers shall be provided within the enclosure to facilitate termination of a separate single-core earth cable.

Earth conductor connections which are regularly disconnected for maintenance of the equipment shall be made with screw type solderless connectors.

Effective continuity of protective circuits shall be maintained between exposed non-current-carrying conductive parts of the control panel components and the enclosure, and between the enclosure and the earth rail/earth stud.

The minimum size of earth conductors shall be 2.5 mm^2 for internal earth connections. Earth conductors shall be yellow/green coloured insulated flexible copper wires.

Removable metal parts, including doors, shall be earthed.

All earthing connections shall be accessible to allow checking of tightness and electrical contact.

4.8 MARKING

All external operating, measuring and indicating devices shall be clearly identified with permanent descriptive labels that facilitate easy recognition by the operator. Descriptive labels shall be white with black lettering. All components shall be identified by labels inscribed in accordance with the system of identification as shown on the Manufacturer's reference drawings and documents.

All labels shall be of corrosion-resistant material with indelible inscriptions in the language specified in the requisition.

Rail-mounted terminals of equipment and components shall be identified by numerical or alphabetical markings in accordance with the Manufacturer's drawings. Terminals of input and output supply cables shall be clearly marked to indicate the nominal system voltage and the phase/polarity of the supply. The identification of terminals shall be in accordance with IEC 445.

The following information shall be clearly marked on a non-destructive, corrosion-resistant, indelible name/rating plate attached to a permanent part of the unit enclosure:

- purchaser's order number
- year of manufacture
- name of the Manufacturer
- type and serial number of unit
- nominal input current/voltage
- nominal output current/voltage
- number, type and capacity of battery cells.

4.9 FINISH

The treatment and protection of metal work may be in accordance with the Manufacturer's standard but shall include cleaning, degreasing, rust resisting primers and paint finishes to provide effective protection against corrosion under the site conditions given in the requisition.

5. ADDITIONAL REQUIREMENTS FOR NAVIGATIONAL AIDS IN HAZARDOUS AREAS

5.1 GENERAL

The requisition will specify which navigational aids units and accessories shall be suitable for operation in a hazardous area.

All equipment for installation in a hazardous area shall comply with the recommendations as laid down in IEC 79.

The following types of protection are acceptable, in sequence of preference:

- type of protection "e" in accordance with IEC 79-7
- type of protection "d" in accordance with IEC 79-1
- type of protection "p" in accordance with IEC 79-2

Depending on the installation, operating and shutdown philosophy, a combination of an industrial type rectifier and an Ex certified battery branch/DC distribution/light and sound signal control and monitoring system will be specified in the requisition. The initiation of a remote gas alarm signal to these combinations must lead to a fully isolated rectifier including its alarm and control circuitry.

5.2 CONTROL PANELS IN EXPLOSION PROOF EXECUTION

The NCCP in Ex execution as specified in (5.1) may consist of a self supporting frame mounted assembly comprising:

- industrial rectifier in a sheet steel enclosure
- one or more explosion proof housings containing the DC distribution, light and sound signal control and monitoring sections.

All main DC power switching devices and all monitoring and control devices required for normal operating actions and checks shall be mounted at the front of the explosion proof panels or enclosures.

5.3 CERTIFICATES AND DECLARATIONS

The requirements for certificates of conformity and declarations of compliance shall be met in accordance with DEP 33.64.10.10-Gen.

6. INSPECTION AND TESTS

6.1 GENERAL

Prior to despatch, the Manufacturer shall verify by testing that the operation of the assembled navigational aids system complies with the requirements specified in the purchase order. The Manufacturer shall submit to the Principal a report incorporating measurements and results of all tests performed in (6.2).

If specified in the requisition, the Principal shall witness the functional tests (6.3) and shall carry out an inspection of the assembled units and related documents to verify compliance with the requirements of the purchase order and this specification.

The inspection and tests of the assembled units should include the battery to be supplied as part of the purchase order. If the battery cannot be included in the tests, then a battery of equivalent rating and capacity shall be substituted and the tests shall be confined to verifying the performance of the rectifier and auxiliary equipment.

Note: The battery to be supplied as part of the purchase order will not normally be included in the tests if the battery is to be shipped by air or sea freight, since under such circumstances the cells will be transported dry. The substitute battery shall then serve only to verify the performance of the rectifier and auxiliary equipment.

Inspection and tests of the rectifier and battery are specified in DEP 33.65.50.31-Gen.

Prior to the commencement of any test, the Manufacturer shall make all relevant adjustments to the protection and control components of the units as necessary to fulfil the requirements of the purchase order and this specification. The rectifier output voltage and current limits shall be set to the appropriate values for the type and number of battery cells to be supplied with the unit, and to the relevant cell temperature specified in the requisition.

6.2 PRODUCTION TESTS

During the production of the navigational aids, the Manufacturer shall perform all activities, functions and tests to prove that the requirements of this specification are met.

6.3 PERFORMANCE TESTS

The complete navigational aids system shall be assembled at the Manufacturer's works with all the necessary interconnecting cabling.

Unless otherwise specified in the requisition, the performance test shall include at least the following:

6.3.1 Insulation tests

The voltage specified in the following table shall be applied for one minute to the circuits indicated:

Table of withstand voltages	Control electronics < 60 V	Power electronics Voltage Level Un1	Auxiliary circuits Voltage Level Un2
To earth	700V D.C.	2 x Un1 + 1000V	2 x Un2 + 1000V
To control electronics	- -	2 x Un1 + 1000V	2 x Un2 + 1000V
To power electronics	2 x Un1 + 1000V	- -	2 x Un1 + 1000V
To auxiliary circuits	2 x Un2 + 1000V	2 x Un1 + 1000V	- -

D.C. instead of A.C. test voltages may be applied. The magnitude of D.C. test voltages to be applied shall be 1.414 times the above mentioned A.C. (r.m.s.) values.

6.3.2 Load-duration test

Each NCCP together with its rectifier supplied as part of the purchase order shall be subjected to a load-duration test performed at rated voltage for a period of not less than 48 hours prior to the execution of functional tests. The Manufacturer's test reports shall state the date and time on which the load-duration test was performed and shall record details of load current and any circuit or component malfunction identified during the test period.

6.3.3 Functional tests

Functional tests shall be performed on the complete navigational aids system. If an electronic component of a unit is required to be replaced during the execution of functional tests then the load-duration test (6.3.2) shall be repeated at rated current, followed by a repeat of the functional tests. Rectifier malfunction or failure of the unit to fulfil the performance requirements of this specification (3) shall be deemed as component failure.

The functional tests to be performed shall be subject to the approval of the Principal. The Manufacturer's test reports shall include at least the results of the following:

6.3.3.1 Rectifier load test in accordance with DEP 33.65.50.31-Gen.

6.3.3.2 Battery discharge test (see 6.1) in accordance with DEP 33.65.50.31-Gen.

6.3.3.3 Light and sound signal control panel section - verification of:

- "U" coders
- "U" coder monitoring and automatic transfer and alarm circuitry
- current monitoring circuitry
- remote start/stop/alarm facilities
- local start/stop/reset functions
- earth fault monitoring systems
- memory function of fault diagnostic and status indication logic
- inverter monitoring, automatic transfer and alarm circuits.

6.3.3.4 Light - verification of:

- local coders and synchronization facilities (if provided)
- automatic lamp changer arrangement (if provided)
- voltage and current to the filament lamps.

6.3.3.5 Photocell - verification of switch function (approximately 100 lux)

6.3.3.6 Sound signal - verification of:

. voltage and current
. frequency
. synchronization facilities.

6.3.3.7 Visibility detector - verification of:

. visibility detector switch function by simulating visibility and using a 2 nautical miles calibration unit
. visibility detector malfunction alarm.

6.3.4 Visual inspection

The following checks shall be undertaken:

. manufacturing drawings against the approved drawings
. availability of instruction and maintenance manuals
. dimensions of enclosures and individual pieces of equipment
. enclosure degree of protection of panels and individual pieces of equipment
. accessibility of components and IP 20 protection
. mounting provisions
. availability of eye bolts for lifting of heavy components
. the reliability of operating mechanisms and locks
. the mains isolators are padlockable in the OFF position
. voltage/current rating of power semiconductor elements
. terminal and wiring marking
. space available for cable termination, size and number of terminals and cable supporting devices
. wiring is not fixed directly to metal parts
. earthing of enclosures and enclosure doors containing electrical equipment
. marking of components in according with the relevant drawings
. rating plates of main components according to specification.
. availability of type test reports from an independent authority for lights and sound signals.

7. DOCUMENTS

7.1 GENERAL

All documents shall be marked in the right-hand bottom corner with the Principal's order and item number together with the Manufacturer's references.

All documents shall be in English and be distributed as specified in DEP 40.10.01.93-Gen.

7.2 TECHNICAL INFORMATION

The Manufacturer will be required to furnish as a minimum the following information and data:

- general arrangement drawings of all equipment, also showing masses, arrangement of components, cable entry details, minimum space required for erection and maintenance
- main and control circuit schematic diagrams including connection diagrams
- equipment data sheets and parts lists
- recommended spare parts lists
- certificates of luminous and audible intensities of equipment
- operating manuals incorporating a functional description of the system, installation, commissioning, operating and maintenance instructions, and fault finding procedures
- copies of the certificates issued by a nationally recognised testing authority for equipment to be used in a hazardous area
- list of special tools.

8. REFERENCES

In this specification reference is made to the following publications:

Note: Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments, supplements or revisions thereto.

SHELL STANDARDS

Index to DEP publications and standard specifications	DEP 00.00.05.05-Gen.
Electrical engineering guidelines	DEP 33.64.10.10-Gen.
Static DC UPS unit	DEP 33.65.50.31-Gen.
Requisition for DC UPS unit	DEP 33.65.50.93-Gen.
Requisition for navigational aids system	DEP 33.80.00.94-Gen.
Requisition for engineering documents	DEP 40.10.01.93-Gen.
Spare parts for initial and normal operation	DEP 70.10.90.11-Gen.

EUROPEAN STANDARDS

Standard procedures for terrestrial photovoltaic performance measurements	CEC 101
Qualification test procedures for crystalline silicon photovoltaic modules	CEC 503

Issued by:
Joint Research Centre
Institute for Systems Engineering and Information
21020 Ispra Varese
Italy

GERMAN STANDARDS

Specification for radio interference suppression of electrical appliances and systems	VDE 0875

Issued by:
Beuth Verlag GmbH
Burggrafenstrasse 4-10
D-1000 Berlin 30
Germany

INTERNATIONAL STANDARDS

International electrotechnical vocabulary	IEC 50
Electrical apparatus for explosive gas atmospheres	IEC 79
Part 1: Construction and verification test of flameproof enclosures of electrical apparatus	IEC 79-1
Part 2: Electrical apparatus-type of protection "p"	IEC 79-2
Part 7: Increased safety "e"	IEC 79-7
Part 15: Electrical apparatus with type of protection "n"	IEC 79-15

Semiconductor converters	IEC 146
Part 1-3: Transformers and reactors	IEC 146-1-3
Identification of terminals	IEC 445
Classification of degrees of protection provided by enclosures	IEC 529
Photovoltaic devices	IEC 904
Part 1: Measurement of photovoltaic current-voltage characteristics	IEC 904-1
Part 2: Requirements for reference solar cells	IEC 904-2
Part 3: Measurement principles for terrestia photovoltaic (PV) solar devices with reference spectral irradiance data	IEC 904-3
Low voltage switchgear and control gear	IEC 947
Part 2: Circuit-breakers	IEC 947-2
Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units	IEC 947-3
Part 4: Contactors and motor starters Section one - Electromechanical contactors and motor starters.	IEC 947-4-1

Issued by:
Central office of IEC (sales dept.)
3, Rue de Varembé
1211 Geneva 20
Switzerland

Recommendations for the marking of offshore structures November 1984 (amended 1987)	IALA recommendations
Recommendations for the calculation of the effective intensity of a rhythmic light	IALA recommendations
Recommendation for the calculation of the range of a sound signal	IALA recommendation
Recommendation on maritime radar beacons (racons)	IALA recommendation
The definition and method of calculation of the nominal range and the usual range of a sound signal	IALA report
Solar photovoltaic systems	IALA specification

Issued by:
International Association of Lighthouse Authorities
13, Rue Yvon Villarceau
75116 Paris
France

International Standards and Recommended Practices	ICAO report
- Aerodromes	Annex 14

Issued by:
International Civil Aviation Organisation
Attention: Distribution Officer
1000 Sherbrook Street West
P.O. Box 400, Place de l'Aviation Internationale
Montreal, Quebec
Canada H3A 2R2

9. APPENDICES

Appendix

APPENDIX 1 COMPARISON OF NATIONAL NAVIGATIONAL AIDS REQUIREMENTS FOR OFFSHORE STRUCTURES

Country	United Kingdom	Norway	Malaysia, Brunei, Nigeria	Netherlands
Base documents	See Notes: (2) and (4)	See Notes: (3) and (5)	See Notes: (1)	See Notes: (1) and (6)
1. Main Lights				
Effective intensity (cd)	12000	12000	1400	1400
Range (nautical miles)	Not specified	15	Not specified	Not specified
Colour	White	White	White	White
Flash character/period	Morse code "U"/15 s Dot = dark period Dash = 3 x dot Eclipse 8-12 s	Morse code "U"/15 s Dot = dark period Dash = 3 x dot Eclipse 8-12 s	Morse code "U"/max. 15 s Not further specified	Morse code "U"/15 s 0.5 s on - 0.5 s off 0.5 s on - 0.5 s off 1.5 s on - 11.5 s off
Synchronisation with	Main/secondary lights	Main lights	Main lights	Main lights
Vertical divergence in degrees	2.5	2.5	Immediate vicinity to max. luminous range	Immediate vicinity at height 5 m above sealevel to max. luminous range
Mounting height	12-30 m above MHWS	12-30 m above MHWS	6-30 m above MHWS	12-30 m above MHWS
Min. back-up time of independent power source (battery)	N/A	N/A	Not specified	36 hours
Utilisation	15 min before sunset until sunrise and when visibility 2 nautical miles or less	15 min before sunset until sunrise and when visibility 2 nautical miles or less	At night	Sunset to sunrise
Quantity of lights	At least one light to be seen over 360 degrees	At least one light to be seen over 360 degrees	At least one light to be seen over 360 degrees	At least one light to be seen over 360 degrees
Alarm	Yes, in control room	Yes, in permanently manned control room	Not specified	Not specified

APPENDIX 1 (cont'd)

Country	United Kingdom	Norway	Malaysia, Brunei, Nigeria	Netherlands
Base documents	See Notes: (2) and (4)	See Notes: (3) and (5)	See Notes: (1)	See Notes: (1) and (6)
2. Secondary Lights				
Effective intensity (cd)	1200	Not specified	N/A	N/A
Range (nautical miles)	Not specified	10	N/A	N/A
Colour	White	White	N/A	N/A
Flash character/period	Morse code "U"/15 s Dot = dark period Dash = 3 x dot Eclipse 8-12 s	Morse code "U"/15 s Dot = dark period Dash = 3 x dot Eclipse 8-12 s	N/A	N/A
Synchronisation with	Main/secondary lights	Secondary lights	N/A	N/A
Vertical divergence in degrees	2.5	2.5	N/A	N/A
Mounting height	12-30 m above MHWS	12-30 m above MHWS	N/A	N/A
Min. back-up time of independent power source (battery)	4 days (96 hours)	96 hours	N/A	N/A
Utilisation	Auto-on upon failure of main lights	Auto-on upon failure of main lights	N/A	N/A
Quantity of lights	At least one light to be seen over 360 degrees	At least one light to be seen over 360 degrees	N/A	N/A
Alarm	Yes, in control room	Yes, in permanently manned control room	N/A	N/A

APPENDIX 1 (cont'd)

Country	United Kingdom	Norway	Malaysia, Brunei, Nigeria	Netherlands
Base documents	See Notes: (2) and (4)	See Notes: (3) and (5)	See Notes: (1)	See Notes: (1) and (6)
3. Subsidiary Lights				
Effective intensity (cd)	15	15	N/A	200
Range (nautical miles)	Not specified	3	N/A	Not specified
Colour	Red	Red	N/A	White
Flash character/period	Morse code "U"/15 s Dot = dark period Dash = 3 x dot Eclipse 8-12 s	Morse code "U"/15 s Dot = dark period Dash = 3 x dot Eclipse 8-12 s	N/A	Steady burning
Synchronisation with	Subsidiary lights	Subsidiary lights	N/A	N/A
Vertical divergence in degrees	2.5	2.5	N/A	Immediate vicinity at height 5 m above sea level to max. luminous range
Mounting	Not specified	Beam axis at horizon	N/A	Not specified
Mounting height	12-30 m above MHWS	Not specified	N/A	12-30 m above MHWS
Min. back-up time of independent power source (battery)	Not specified	Not specified	N/A	36 hours
Utilisation	15 min before sunset until sunrise	15 min before sunset until sunrise	N/A	Sunset to sunrise
Quantity of lights	Other horizontal extremities or use main/ sec. lights	Other horizontal extremeties or use main/ sec. lights	N/A	Other horizontal extremities or use main lights

APPENDIX 1 (cont'd)

Country	United Kingdom	Norway	Malaysia, Brunei, Nigeria	Netherlands
Base documents	See Notes: (2) and (4)	See Notes: (3) and (5)	See Notes: (1)	See Notes: (1) and (6)
4. Main Sound Signals				
Minimum sound pressure level in dB(A) at distance (m)	Not specified	Not specified	Not specified	116 @ 7.60
Usual range (nautical miles)	2	2	2	2
Blast character/period	Morse code "U"/30 s 0.75 s on - 1.0 s off 0.75 s on - 1.0 s off 2.5 s on - 24.0 s off	Morse code "U"/30 s 0.75 s on - 1.0 s off 0.75 s on - 1.0 s off 2.5 s on - 24.0 s off	Morse code "U"/30 s Short blast - 0.75 s	Morse code "U"/30 s 0.75 s on - 1.0 s off 0.75 s on - 1.0 s off 2.5 s on - 24.0 s off
Synchronisation with	Main/secondary signal	Main signal	Main signal	Main signal
Mounting height	12-35 m above MHWS	12-35 m above MHWS	6-30 m above MHWS	6-30 m above MHWS
Min. back-up time of independent power source (battery)	4 days (96 hours)	96 hours	Not specified	36 hours
Utilisation	Whenever visibility is 2 nautical miles or less	Whenever visibility is 2 nautical miles or less	Whenever visibility decreases below 2 nautical miles range	Whenever visibility decreases below 2 nautical miles range
Quantity of signals	To cover 360 degrees	To cover 360 degrees	To cover 360 degrees	To cover 360 degrees
Alarm	Yes, in control room	Yes, in permanently manned control room	Not specified	Not specified

APPENDIX 1 (cont'd)

Country	United Kingdom	Norway	Malaysia, Brunei, Nigeria	Netherlands
Base documents	See Notes: (2) and (4)	See Notes: (3) and (5)	See Notes: (1)	See Notes: (1) and (6)
5. Secondary Sound Signals				
Usual range (nautical miles)	0.5	0.5	N/A	N/A
Blast character/period	Morse code "U"/30 s 0.75 s on - 1.0 s off 0.75 s on - 1.0 s off 2.5 s on - 24.0 s off	Morse code "U"/30 s 0.75 s on - 1.0 s off 0.75 s on - 1.0 s off 2.5 s on - 24.0 s off	N/A	N/A
Synchronisation with	Main/secondary signal	Not specified	N/A	N/A
Mounting height	12-35 m above MHWS	12-35 m above MHWS	N/A	N/A
Min. back-up time of independent power source (battery)	4 days (96 hours)	96 hours	N/A	N/A
Utilisation	Auto start when range of main signal falls below 0.5 nautical miles	Auto start when range of main signal falls below 0.5 nautical miles	N/A	N/A
Quantity of signals	To cover 360 degrees	To cover 360 degrees	N/A	N/A
Alarm	No	No	N/A	N/A

Notes:

Numbers refer to base documents as listed below:

(1) IALA - Recommendations for the marking of offshore structures
(2) IALA - Recommendations for the marking of offshore structures - Appendix 1
(3) IALA - Recommendations for the marking of offshore structures - Appendix 2
(4) Department of Transport UK - Standard marking schedule for offshore installations
(5) Norwegian Petroleum Directorate - Regulations concerning marking of installations in the petroleum activities
(6) Dutch Mining Regulations CS Art. 41 and further rules

N/A Not applicable

APPENDIX 2 ADDITIONAL REQUIREMENTS FOR SOLAR PHOTOVOLTAIC POWER SUPPLY SYSTEMS

A.2.1 SCOPE

This appendix states the additional minimum requirements for the design and manufacturing of a solar photovoltaic power supply system consisting of solar modules, a battery, control equipment, mechanical support means and associated components. For general requirements see (1) through (7) of the main body of this DEP.

The system shall comply with the requirements of IALA specification for "Solar Photovoltaic Systems" and IEC 904-1-2-3 or CEC 101 and CEC 503.

A.2.2 DESIGN AND CONSTRUCTION

A.2.2.1 General Design Conditions

The solar photovoltaic power supply system shall be designed for satisfactory operation under site and load conditions as mentioned in the specification and the requisition.

When specified in the requisition all components shall be fully suitable for installation in a Zone 1 or Zone 2 hazardous area.

The battery shall have a lifetime of minimum five years. The requirements of (2.1) do not apply for this purpose.

A.2.2.2 Basic Requirements

The size of the system shall be such that the energy requirements of the load can be met by storage in the battery after charging by the solar modules even under the minimum anticipated annual insolation conditions.

The battery shall have sufficient capacity to meet the back-up time specified in the requisition, with the batteries at the maximum DDOD and with minimum or insufficient insolation during the intervening days, considering a minimum state of charge of the battery of 20%.

From the minimum state of charge level mentioned in the foregoing paragraph, the system shall also under conditions of minimum daily average insolation recharge the battery to full charge level, while at the same time supplying rated power output to the load.

Unless otherwise specified in the requisition, the solar module rating shall be such that at any moment the battery charge factor shall be minimum 1.2, and the DDOD shall not be

more than 15% of full capacity, depending on type of battery and ambient temperature of the battery location.

If the solar modules are installed at a significant distance from the load and/or battery, attention shall be given to the selection of the output voltage and the cross-sectional area of the cabling to avoid unacceptable losses.

Site and panel temperatures must be taken into account for the performance of the solar modules.

Electrical connections shall be made to a junction box in which two bypass diodes shall be incorporated to prevent hot spots. Each diode shall have a minimum direct current value of three times the short circuit current of the array on which it is installed.

A.2.2.3 Insolation Data

Unless insolation data is provided by the Principal, insolation data from internationally recognized sources shall be used by the Manufacturer for the design of the solar power system. The Manufacturer shall submit to the Principal detailed information on his source of insolation data together with his design of the solar power system.

A.2.2.4 Solar Photovoltaic Power Supply System Information

The Manufacturer shall submit the following information prior to commencement of detailed engineering.

- Number of solar modules and the average output of each solar module under Standard Test Conditions, and at 40 °C and 60 °C cell temperatures.
- Average output of each solar module under the expected operational and environmental conditions.
- The load pattern (min., average and max. currents)
- The battery capacity at the specified discharge rate.
- Battery charge factor (efficiency).
- Acceptable maximum DDOD.
- Calculated maximum DDOD.
- Calculated average DDOD.
- Acceptable minimum state of charge.
- Calculated minimum battery back-up time.
- Calculated average battery back-up time.
- The maximum time taken to fully charge the battery at the end of the back-up time (seasonal storage for high latitudes).
- Tilt angle of the solar modules.
- The maximum, average, and minimum terminal voltage supplied to the equipment during

day and night.
- System losses and derating factors due to:
  . charge efficiency of the batteries
  . ageing
  . dust deposit
  . environmental conditions (temperature, wind, sandstorms, hail)
  . insolation variation due to normal year to year statistical changes
  . current consumed by control equipment, metering and alarm system
  . losses in control equipment, wiring, fuses, diodes and circuit breakers.
- Charge/discharge controller particulars.
- Spectral response curve.
- Conformance to hail test.
- The life of modules and battery.
- The ratio of collecting area compared to the total area.
- Full material descriptions of the solar modules:
  . front and back cover material
  . sealant and encapsulation.

The Manufacturer shall submit evidence of satisfying the basic requirements of para 2.2.2 of this Appendix by means of a design and system simulation taking into account all parameters mentioned in this paragraph.

A.2.2.5 Solar Modules

The solar modules shall be mounted on a frame suitable for installation at site. This frame shall be designed for tilting to the optimum angle for absorption of solar energy and also for creating a self-cleaning washing of the modules surface when it rains. The frame shall be supplied with holes or slides for mechanical attachment and shall be made of non-corrodible material.

A.2.2.6 Battery

The battery shall be specially designed for photovoltaic applications and shall be suitably sized for the system.

Site temperature limits shall be taken into account in the selection of the battery type due to the effect on available capacity and lifetime expectancy.

The batteries shall be mounted in a corrosion and battery electrolyte resistant enclosure or rack.

The batteries shall be arranged to facilitate access for maintenance purposes. Intercell connectors shall be provided. The use of parallel arrangements should be avoided. Where

batteries are connected in parallel, load equalisation between branches shall be assured.

A.2.2.7 Control Equipment

A charge/discharge controller shall ensure proper charging and discharging of the batteries through the following functions:

- dual voltage regulation to cater for boost and float charge operation.
- overcharge protection of the batteries by switching off the solar array from the system if the battery is already fully charged.
- battery protection by switching off the load from the system if the voltage drops below a voltage limit or an optional alarm contact for warning of low battery voltage
- temperature compensation on maximum charge voltage
- prevention of overnight discharge of the batteries through the solar module
- protection against overvoltage from the solar module output.
- protection against overload and short circuit conditions in the navigational aids units (load).

The control equipment, including LED's to indicate the system status, shall have the following minimum functions:

- battery voltage below minimum voltage
- battery voltage above maximum voltage
- voltage-free contacts for remote display of status and alarms.

Failure of the charge/discharge controller shall not result in catastrophic failure of the whole system.

A.2.2.8 Auxiliary Equipment

A control and distribution box shall be provided containing the system performance monitoring and control equipment, an on/off switch operated from outside the enclosure, fused terminals for loads, and certified cable glands corresponding with the installation cables.

The interconnection between the solar array and the control and distribution box shall be made by means of a cable with a plug and socket. This arrangement facilitates the electrical isolation of the solar modules from the system for repair or replacement.

The interconnection between the battery box and the control and distribution box shall be made by means of a cable with a plug and socket. This arrangement facilitates the electrical isolation of the battery bank from the system for inspection and maintenance purposes.

Interconnecting cables will be supplied by others; the Manufacturer shall provide plugs to

match the respective sockets on the fixed equipment. The plugs shall be fitted with cable glands suitable for the cables supplied. The Manufacturer shall advise the Principal of the size and type of cable required.

A.2.3 TESTS

For general test requirements see (6) of the main body of this DEP.

The following additional test is required:

Solar Modules

Measurement of typical values of module short circuit current and open circuit voltage.

APPENDIX 3 ADDITIONAL REQUIREMENTS FOR HELIDECK LANDING LIGHTS AND AERONAUTICAL OBSTRUCTION LIGHTS

A.3.1 SCOPE

The requirements as laid down in annex 14 of the ICAO report shall be met.

This appendix states the additional minimum requirements for design and manufacture of helideck landing lights and aeronautical obstruction lights. For general requirements see (1) through (7) of the main body of this DEP.

A.3.2 HELIDECK LANDING LIGHTS

A.3.2.1 Application

The touch-down and lift-off area lighting system for the helideck shall comprise:

- perimeter lights
- floodlighting

A.3.2.2 Characteristics

The average horizontal illuminance of the floodlighting should be at least 10 lux, measured on the surface of the touchdown and lift-off area, with a uniformity ratio (average to minimum) of not more than 8:1.

A.3.2.3 Special Construction Requirements

The perimeter light and floodlight assemblies including the light sources shall be designed to withstand heavy vibrations and impulses typical of helideck landing areas.

Permiter light and floodlight enclosures shall be made of AISI 316 L stainless steel and be provided with light sources with a minimum life expectancy of 8000 hours.

Note: Filament lamps shall not be used.

Perimeter lights and helideck floodlights shall be equipped with through wiring provisions. All domes shall be provided with guards.

A perimeter light and a floodlight may be combined in one enclosure.

A.3.2.4 Back-up Power Supply

The requirement for back-up power supply for helideck landing lights shall be specified in the requisition.

A.3.3 AERONAUTICAL OBSTRUCTION LIGHTS

A.3.3.1 Location

Aeronautical obstruction lights shall be fitted at the highest point of the platform obstacles such as towers and vent stacks. When top mounting is impractical, e.g. near heat sources, it is permitted to install obstruction lights three metres below the top of the structure.

Aeronautical obstruction lights shall be installed such that at least one light can be seen by a pilot from any point above the horizon.

Where the height of the obstacle related to MHWS exceeds 45 metres, either a second diagonally mounted pair of aeronautical obstruction lights shall be mounted half way between the top and MHWS, or at every interval of 45 metres maximum.

A.3.3.2 Special Construction Requirements

The obstruction light assembly including the light source shall be designed to withstand heavy vibration.

Since aeronautical obstruction lights will normally be installed at relatively inaccessible locations, lamps with long replacement intervals such as dual neon tubes with automatic change-over, or automatic lamp changers, shall be used.

A.3.3.3 Back-up Power Supply

The requirement for back-up power supply for aeronautical obstruction lights shall be specified in the requisition.

APPENDIX 4 ADDITIONAL REQUIREMENTS FOR RADAR BEACONS (RACONS)

A.4.1 SCOPE

Racons shall comply with IALA Recommendation on maritime radar beacons (racons).

This appendix states the additional minimum requirements for the design and manufacturing of racons. For general requirements see (1) through (7) of the main body of this DEP.

A.4.2 APPLICATIONS

Racons are installed as an aid to shipping. Racons are in principle transponders which upon detection of a radar signal respond with a signal on the same frequency. The signal will be received by the interrogating radar and displayed on the screen.

A.4.3 LOCATION

Since the maximum range for racon reception is fundamentally limited by line of sight, it is normal practice to install racons at a high unrestricted location. The responsible authority should be consulted in crowded shipping areas where proliferation of racons could occur.

A.4.4 CHARACTERISTICS

Racons shall be equipped with side lobe suppression to prevent complete blanketing of the normal radar display when ships pass close to the racon.

A.4.5 BACK-UP POWER SUPPLY

The requirement for back-up power supply for racons shall be specified in the requisition.