IALA GUIDELINE

G1186

OVERVIEW OF A FLOATING ATON

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DOCUMENT HISTORY

Revisions to this IALA Document are to be noted in the table prior to the issue of a revised document.

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December 2024	First issue	Transition Council 3

CONTENTS

CONTENTS

List of Figures

1. INTRODUCTION

Floating Marine Aids to Navigation (AtoN) have been in use for hundreds of years. They have progressed from wooden barrels to high tech steel or plastic floating AtoN with integrated power system lanterns (IPSL) and mounted with complementary equipment like radar reflector, Automatic Identification System (AIS) and radar beacons (racons). Increasingly, remote monitoring system are used for status reporting for the AtoN.

Depending on the navigational risk assessment and the density of traffic in the area, the design of the floating AtoN can differ. Competent authorities and AtoN providers are recommended to do their own risk assessment in accordance with their operational area and environmental conditions.

This guideline is meant to be used as a reference guide for the reader, with the appropriate IALA recommendation or guideline referred to in the individual sections to point the reader for more in depth reading.

2. SCOPE

This guideline has been developed to provide a general overview to assist Competent Authorities, AtoN providers, and AtoN manufacturers when selecting floating AtoN for different purposes, depending on nautical, geographical, and operational requirements.

3. REGULATIONS AND RESPONSIBILITIES

3.1 SOLAS REGULATION AND IALA DOCUMENTS

SOLAS Chapter V Regulation 13 states that AtoNs should be provided where practicable and necessary as the volume of traffic justifies and degree of risk requires. The requirements for any new AtoN will be evaluated by the Competent Authority.

Documents to be aware of from the outset of this process are noted below and both are available on IALA Website:

- R1001 the IALA Maritime Buoyage System (MBS).
- IALA NAVGUIDE: Chapter 3 (Marine Aids to Navigation).

3.2 COMPETENT AUTHORITY

The Competent Authority will undertake a review of the proposed floating AtoN's deployment to evaluate its navigational significance and determine the minimum requirements for the specific site.

The Competent Authority may issue an approval to deploy that officially authorises all AtoN. For AtoN that are seasonal or in position for short durations, a notification can be given by other means, e.g. Notice to Mariners.

The financial and staff resource should be accounted for to ensure the amount of time it may take to obtain the required permissions and approvals at both the installation and decommissioning phases of the floating AtoN's expected lifetime, these will depend upon individual National requirements. It is recommended to contact the Competent Authority for guidance to understand the local process.

See IALA Recommendation R1002 Risk Management for Marine Aids to Navigation and Guideline G1047 Cost Comparison Methodology of Buoy Technologies

3.3 FLOATING ATON OWNER RESPONSIBILITIES

The floating AtoN shall be maintained in good working order and the availability shall be according to the stated requirement from the Competent Authority. The list below illustrates a local regulation, owners of floating AtoN are recommended to check their local regulations:

- The deployment of the floating AtoN is promulgated to the Mariner by means of a Notice to Mariners.
- The Notice to Mariners is copied to the national Hydrographic Office responsible for charting to allow updates to be completed, if required. The Hydrographic Office may include the AtoN into the National List of AtoN.
- Any maintenance, outage or defect, a Radio Navigation Warning and/or Notice to Mariners should be issued to alert the Mariner of the maintenance, outage or defect, throughout the lifetime of the AtoN. Any issued Notice to Mariners should be withdrawn once the AtoN is restored.

4. RESOURCE CONSIDERATIONS

There are further considerations to be taken for resourcing needed for the ownership, operation and subsequent disposal of such assets through their life. This section discusses some of these key demands.

Lifetime cost of the floating AtoN: The lifetime costs of a floating AtoN should be considered during the initial design or selection of the floating AtoN to ensure the correct resources can be assessed and assigned. This will allow for an informed selection of the various technical design specifications and financial budgeting over the expected lifetime of the floating AtoN. There are many resource considerations over the expected lifetime of a floating AtoN depending on its purpose, location and navigational significance; considerations may include:

- Planning for the duration and type of AtoN.
    - How long a floating AtoN is to be deployed will directly impact on the financial costs associated and infrastructure resources needed, some areas to consider are:
        - is the floating AtoN temporary or permanent;
        - is the floating AtoN seasonal and reused every year and what time of year is the deployment; and
        - rental or purchase for a new location.
- Installation and Maintenance:
        - method of installation – to consider the type of vessel, crane and reach of the crane;
        - servicing / refurbishing periodicity; and
        - lifecycle of the equipment installed.
- Decommission Plan:
    - Consideration should be given to the resources needed to achieve the decommissioning plan during the initial proposal stage of a floating AtoN deployment. This is especially true for a temporary floating AtoN. This will allow financial and environmental planning to be undertaken and understood and hence the resources necessary by the floating AtoN owner. The plan could include disposal options or reuse/ recycling of each component depending on wear and tear, and capabilities of the local recycling facility.
- End of Life Disposal:

- The cost associated with end of life should be factored in at initial design to ensure that when the floating AtoN is no longer required or has reached the end of its operational life it can be disposed of in a sympathetic way, where possible recycling or reuse should be considered.

5. FEATURES OF THE FLOATING ATON

The Competent Authority will specify and determine the features of the floating AtoN to be used in line with the IALA MBS, various guidelines and recommendations, including:

- colour/shape (topmark);
- visible range;
- whether to be lit or unlit;
- range and the light's flash characteristics (if necessary to be lit);
- the light's focal plane and stability which could affect the night visibility of the light; and
- suitable mooring system.

5.1 ADDITIONAL EQUIPMENT TO BE CONSIDERED

Additional equipment may be fitted to the floating AtoN to increase its visibility or reliability (please refer to Chapter 10 for list of IALA Recommendations/Guidelines). These complementary equipment depend upon the navigational significance of the floating AtoN and/or environmental conditions. These equipment include:

- Radar reflector (active or passive), symbols/numbering, retroreflective material and audible signal.
- AIS AtoN.
- RACON.
- Synchronisation of lights to any other AtoN within an area.
- Remote monitoring.

6. PARTS OF A TYPICAL FLOATING AID TO NAVIGATION

The four main parts of a floating AtoN, listed from top down, are:

- superstructure/spars;
- float/hull/buoyancy chamber;
- counterweight/ballast; and
- mooring system.

6.1 COMPONENTS OF A FLOATING ATON

The following diagram illustrates a typical floating AtoN, showing its various components.

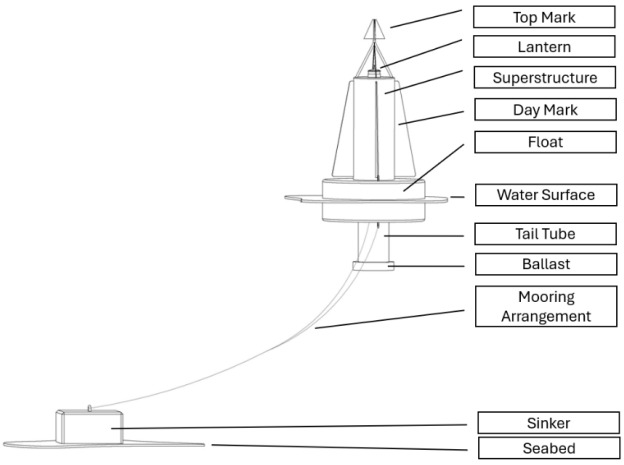

Figure 1 Drawing of a typical floating AtoN

6.2 MATERIAL

Floating AtoNs can be manufactured from metal (steel, aluminium etc), plastic and/or a combination of both. The selection of the construction material will influence the cost and the on-station life, amongst other factors. For further details, refer to the IALA *G1006 Plastic buoys*.

6.3 TOPMARK

The shape of the topmark helps mariners to identify the type of AtoNs. For further details, refer to the IALA *G1094 Daymarks for Aids to Navigation*.

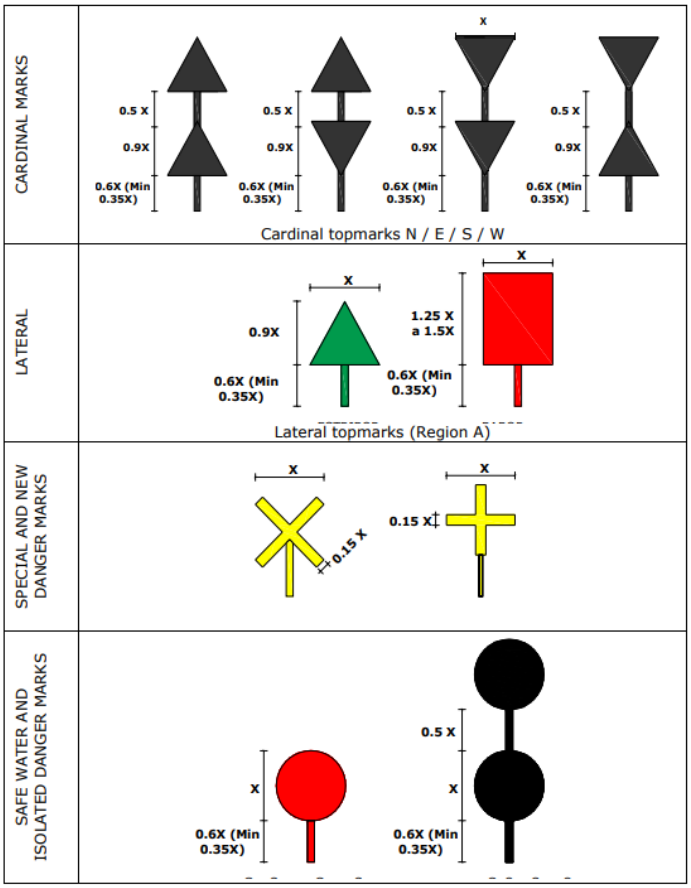

Figure 2 Topmark proportions (taken from IALA G1094 Daymarks for Aids to Navigation)

6.4 AERIALS

The function of an aerial is to support electronic communication. An aerial should be positioned to allow for unobstructed communication. Consideration should be made when using two or more aerials to ensure performance is not impacted by Radio Frequency Interference.

Figure 3 Example of aerials

6.5 RADAR REFLECTOR, RADAR TARGET ENHANCER

Radar reflector or Radar Target Enhancer may be used to improve the electronic return to a ship's radar. For further details, refer to IALA *Guideline G1174 Radar reflectors on marine aids to navigation*.

Figure 4 Examples of Radar reflectors

Figure 5 Example of an active Radar Target Enhancer

6.6 LANTERNS

The primary purpose of a lantern is to assist in the detection and identification of a floating AtoN at night. For further details, refer to *IALA MBS, G1064 Integrated Power System Lanterns and G1065 AtoN Signal Light Beam Vertical Divergence and G1116 Selection of rhythmic characters and synchronization of lights for AtoN*.

Figure 6 Examples of Marine AtoN Lanterns

6.7 AUTOMATIC IDENTIFICATION SYSTEM (AIS) ATON TRANSPONDER

Automatic Identification System (AIS) is an autonomous broadcast system, operating in the VHF maritime mobile band. It provides information of the AtoN such as GNSS location, status of the lantern and positioning information. The information is sent via normalised messages between AIS base stations.

See IALA Guidelines G1098 On the application of AIS – AtoN on buoys, G1062 The Establishment of AIS as an Aid to Navigation and IALA Recommendation R0126 (A-126) The Use of The Automatic Identification System (AIS) In Marine Aids to Navigation Services.

6.8 RADAR BEACONS (RACONS)

Radar Beacons or RACONs are powered devices installed on AtoNs that provide an electronic return to a ship's radar that help to locate and/or identify an AtoN. For further details, refer to IALA *R0101 Marine Radar Beacons (Racons) and Guideline G1010 Racon Range Performance*.

Figure 7 A typical RACON

6.9 AUDIBLE SIGNALS

Audible signals are occasionally fitted to a floating AtoN to enhance the Mariner's awareness during periods of poor visibility. For further details, refer to IALA Guideline G1090, *The Use of Audible Signals*.

Figure 8 Example of an audible signal (Foghorn)

6.10 NAMES/NUMBERS FOR IDENTIFICATION

Names and/or numbers can be used to identify a specific floating AtoN installed at a location. The size of the names and/or numbers should allow it to be seen at a reasonable distance. For further details, refer to *IALA MBS for the specified numbering convention and Recommendation R0106 Retroreflecting Material on Aids to Navigation Marks within the IALA Buoyage System.*

Figure 9 Example of numbering on floating AtoN

6.11 SOLAR PANELS

Most floating AtoN use solar (photovoltaic process) energy as a primary source of power. For further details, refer to IALA *Guidelines G1170 Solar modules for a marine environment, G1039 Designing solar power systems for AtoN (solar sizing tool) and G1067 electrical loads of AtoN.*

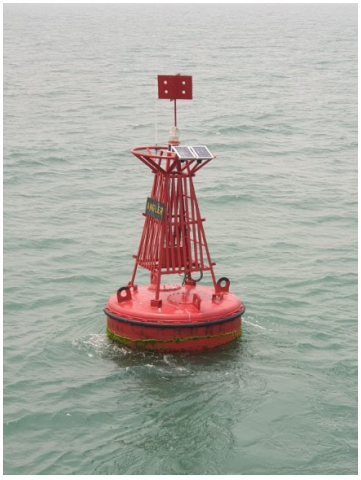

Figure 10 Example of Solar Panels installed on lateral mark

6.12 LEADS AND PLUGS

Any electrical control equipment, mounted within or on a floating AtoN's structure, should have a design life that is suitable for its expected usage and location. Designs should, where possible, only have bottom entry cable runs in and out of control cabinets and consider mounting external indicators or safety disconnection devices in easy-to-access positions.

6.13 SUPERSTRUCTURE

The superstructure on a floating AtoN is essentially a construction placed upon the hull that provides an elevated position for housing a marine AtoN lantern, top mark and any other equipment (such as aerials and radar reflectors etc). The materials used will generally be those that can withstand significant and prolonged exposure to the elements. As the superstructure forms a significant proportion of the total daytime conspicuity of a floating AtoN, considerations must be given to its size and density to be seen from a relative distance. Traditionally, lattice style towers are used as they are inherently strong yet allow wind to blow through, thus having a reduced impact upon stability.

See IALA Guideline G1099 The Hydrostatic Design of Buoys.

Figure 11 Examples of superstructures

6.14 DAYMARKS

Daymarks are additional materials fixed to a floating AtoN's superstructure that can serve to improve daytime visibility. Examples below are illustrations of additional wings.

See IALA Guideline G1094 Daymarks for Aids to Navigation.

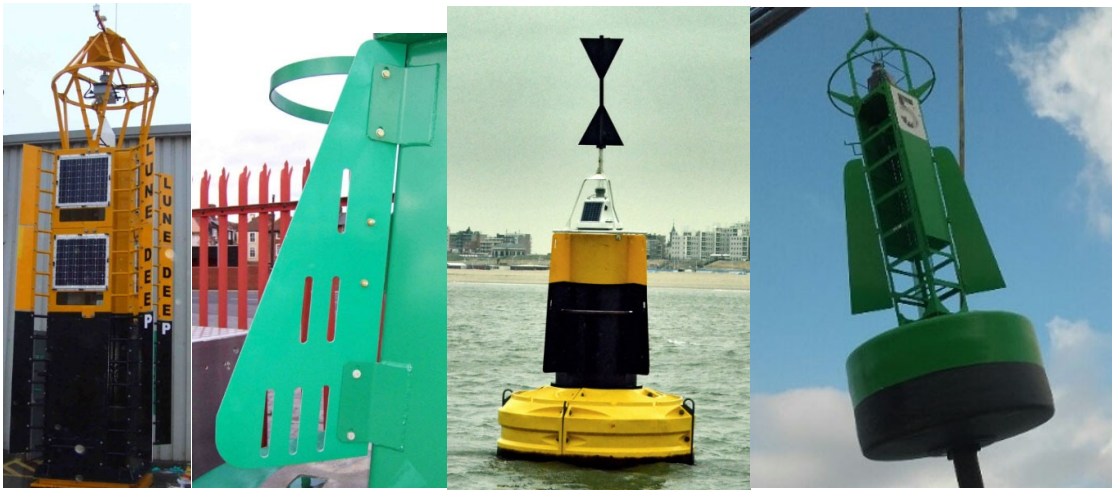

Figure 12 Daymarks (examples of additional wings to improve daytime visibility)

6.15 BATTERIES

The various types of battery energy storage systems in AtoN services are primary batteries (non-rechargeable) and secondary (rechargeable) batteries. For further details, refer to *IALA Guideline G1067-3 Electrical Energy Storage for AtoN.*

6.16 LIFTING LUGS

Most floating AtoNs used in service will require some form of lifting operations undertaken for positioning or transportation. In order for this function to be undertaken safely, consideration within their designs should make suitable allowances for this and the weight of its mooring assemblies.

6.17 COLOURS/COLOUR BREAKS

With reference to the IALA MBS, every deployed floating AtoN should follow the recognised colours and colour combinations. This is important for daytime identification of all types of marks. For further details, refer to *IALA Guidelines G1015 Painting Aids to Navigation Buoys and G1134 Surface Colours used as Visual Signals on AtoN.*

6.18 ANODES

Floating AtoNs may require sacrificial anodes to be installed for prevention of galvanic corrosion to certain components. These anodes generally come in three types of metal – aluminium, magnesium and zinc, and require to be changed at intervals or when depleted.

6.19 MOORING ARRANGEMENTS

Floating AtoN are maintained in position by their moorings according to local conditions. The mooring system must maintain the floating aid in a sufficiently accurate position for it to perform its function as an AtoN. The mooring generally consists of a mooring chain or synthetic rope connecting the floating AtoN to a sinker. In certain cases, the mooring arrangement may require multiple sinkers and mooring chains.

See IALA Guideline G1066 Design of floating aid to navigation moorings.

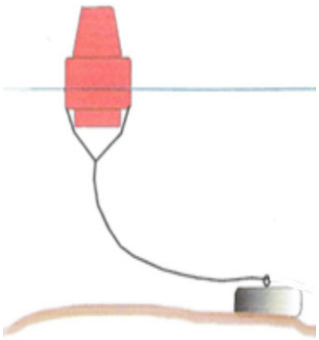

Figure 13 Example of a single point mooring arrangement

6.20 MONITORING

The main purpose of status monitoring is to keep constant surveillance on the working status of the floating AtoN, detect existing or potential failure and intervene in time to ensure that the floating AtoN maintains good performance. Monitoring is an important supplementary means to assess performance of the floating AtoN. As a method to match IALA availability requirement, monitoring result can be used as data to calculate the availability of the buoy. Therefore, its accuracy and comprehensiveness may affect the level of service, which the mariners are expecting from the floating AtoN. Status monitoring is a complex task. There are various methods that have different effects. The relevant parties involved should fully consider the realistic factors and the expected results, and finally make the choice that meets the requirements when deciding the monitoring methods.

See IALA Guideline G1008 Remote control and monitoring of AtoN.

6.21 COMPLEMENTARY USES SUCH AS SENSORS AND ENVIRONMENTAL MONITORING PURPOSES

A floating AtoN can also be used as a platform for installing of additional sensors such as acoustic doppler current profiler or other monitoring equipment for environmental conditions. However, these additional sensors should not interfere with the floating AtoN's shape or daymark, light character (if necessary to be lit), signal transmission or functionality of equipment which can be confusing for the Mariners operating in the area.

Figure 14 Example of a data floating AtoN

7. OPERATING ENVIRONMENT

With the selection and deployment of a new floating AtoN, the environment can influence the types of resources, people, skills and equipment, which will be necessary for the floating AtoN deployment and maintenance. Some of these factors are:

- Location of deployment: Special considerations such as deployment in Marine Protected Areas.

  See IALA Guidelines G1036 Environmental management in AtoN and G1137 AtoN management in protected areas.

- Marine Growth: The location of a new floating AtoN can present an opportunity for many marine species in the form of a new home. Such marine growths will influence the type and frequency of resource need to maintain a floating AtoN. It may also influence how such maintenance is completed, and any waste is managed.

  See IALA Guideline G1077 Maintenance of Aids to Navigation.

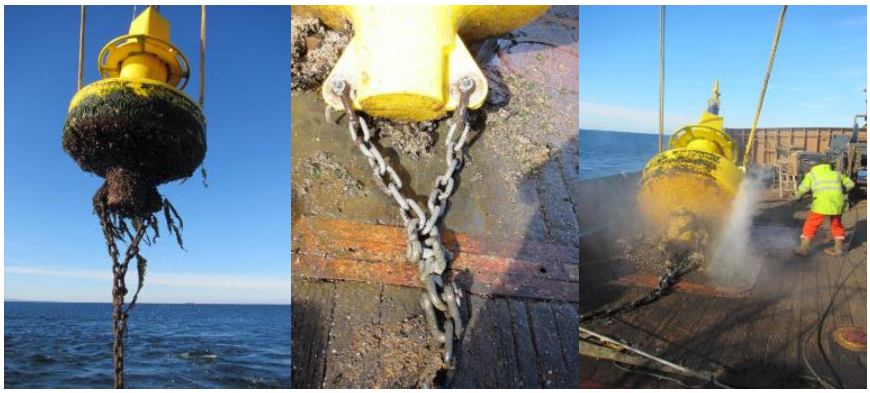

Figure 15 Examples of marine growth

- Invasive species: Consideration should be given to prevention of introducing invasive species when moving a floating AtoN across different localities. Local experience and information will be essential to determine any potential impacts. Floating AtoN owners should ensure buoy tender vessels/ crew adhere to the relevant national guidance and or legislation on invasive species. Such constraints can influence the consideration of how any replacement or maintenance of the floating AtoN is carried out.
- Antifouling: This can be a positive thing from a maintenance resource prospective, reducing the servicing needs by extending the life of the floating AtoN and periods between maintenance or scheduled floating AtoN replacement. However, from an environmental viewpoint, there are concerns associated with use of certain chemical bio inhibitors.
- Operational area: The operational location of a floating AtoN, such as rivers, drying tidal zones, offshore, breaking waves, ice, extreme heat and UV, to name a few, will impact on the floating AtoN design, but may influence the resources that must be put in place for maintenance and response purposes.

  See IALA Guideline G1108 The Challenges of Providing AtoN Services in Polar Regions, G1136 Providing AtoN Services in Extremely Hot and Humid Climates, G1175 AtoN equipment and structures exposed to extreme environmental conditions.

Figure 16 AtoN inspection in extreme conditions

- Guano: The local bird population can impact on the resources need to maintain a particular floating AtoN so that it remains recognisable as its designed mark. It can also cover solar panels, where a sufficient angle of inclination could promote self-cleaning. The design of the floating AtoN can influence the corrosive effects of guano , which can cause damage leading to reduced life or premature failure.

  See IALA Guidelines G1039 Designing Solar Power Systems for Aids to Navigation, G1091 on Bird deterrents and bird fouling solution and G1094 Daymarks for Aids to Navigation.

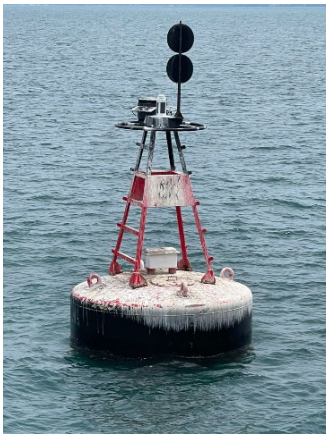

Figure 17 Example of guano on floating AtoN (an Isolated Danger Mark)

8. DEFINITIONS

The definitions of terms used in this IALA Guideline can be found in the International Dictionary of Marine Aids to Navigation (IALA Dictionary) and were checked as correct at the time of going to print. Where conflict arises, the IALA Dictionary should be considered as the authoritative source of definitions used in IALA documents.

9. ACRONYMS

AtoN	Marine Aids to Navigation
AIS	Automatic Identification System
GNSS	Global Navigation Satellite System
IMO	International Maritime Organization
IPSL	Integrated Power System Lantern
MBS	Maritime Buoyage System
RACON	Radar Beacon

10.REFERENCES

IALA. R1001 The IALA Maritime Buoyage System

IALA. R1002 Risk Management for Marine Aids to Navigation

IALA. R0101 Marine Radar Beacons (Racons)

IALA. R0106 Retroreflecting Material on Aids to Navigation Marks within the IALA MBS

IALA. R0107 Moorings for Floating Aids to Navigation

IALA. R0108 Surface Colours Used as Visual Signals on Marine Aids to Navigation

IALA. R0126 (A-126) The Use of The Automatic Identification System (AIS) In Marine Aids to Navigation Services

IALA. R0130 Categorisation and Availability Objectives for Short Range Aids to Navigation

IALA. G1006 Plastic Buoys

IALA. G1010 Racon Range Performance

IALA. G1015 Painting Aids to Navigation Buoys

IALA. G1036 Environmental management in AtoN

IALA. G1039 Designing solar power systems for AtoN

IALA. G1047 Cost Comparison Methodology of Buoy Technologies

IALA. G1062 The Establishment of AIS as an Aid to Navigation

IALA. G1064 Integrated Power System Lanterns

IALA. G1065 AtoN Signal Light Beam Vertical Divergence

IALA. G1066 Design of floating aid to navigation moorings

IALA. G1067 Electrical loads of AtoN

IALA. G1067-3 Electrical Energy Storage for AtoN

IALA. G1090 The Use of Audible Signals

IALA. G1094 Daymarks for Aids to Navigation

IALA. G1098 The Application of AIS-AtoN on Buoys

IALA. G1099 The Hydrostatic Design of Buoys

IALA. G1116 Selection of rhythmic characters and synchronization of lights for AtoN

IALA. G1134 Surface Colours used as Visual Signals on AtoN

IALA. G1170 Solar modules for a marine environment

IALA. G1174 Radar reflectors on marine aids to navigation

IALA. G1137 AtoN management in protected areas

IALA. G1175 AtoN equipment and structures exposed to extreme environmental conditions

IALA. G1077 Maintenance of Aids to Navigation

IALA. G1039 Designing Solar Power Systems for Aids to Navigation

IALA. G1091 on Bird deterrents and bird fouling solution

IALA. G1168 Quality Control for Third Party AtoN Service Providers

IALA. G1008 Remote control and monitoring of AtoN

IALA. G1108 The Challenges of Providing AtoN Services in Polar Regions

IALA. G1136 Providing AtoN Services in Extremely Hot and Humid Climate