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| IALA Guideline |

Gnnnn

use of drones for aton management

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# Introduction

During the Competent Authority’s inspection of marine Aid(s) to Navigation (AtoN), such as lighthouses and underwater breakwaters, on-site inspectors face difficulties accessing the site directly, exposing them to danger and limiting their ability to thoroughly check the facility's condition. Drone inspections could be effective in areas of harsh weather.

AtoN authorities have introduced drones for safety inspections of high-rise structures like lighthouses, beacons, and hard-to-reach objects or hazards. Drone operations within this document include aerial, floating, and underwater devices. By utilizing drones for AtoN inspections, it becomes feasible to capture footage of high-rise marine facilities and analyze videos, which are typically challenging to visually inspect. This approach addresses problems such as marine traffic safety blind spots, stemming from difficulties in accessing and inspecting sites. Consequently, it facilitates efficient and effective AtoN maintenance work.

Drone equipped with cameras and Real-Time Kinematic (RTK) modules are capable of capturing high-quality images and recording accurate geo-data, providing more detailed and consistent information about the state of AtoN such as position, damage, and failure.

The use of drones may lead to safe operation of staffs and cost effective method of inspecting AtoN while supporting sustainability, climate change, and reduction in vessel use and emissions. Data analysis and documentation in conjunction with administration of the AtoN is streamlined by a uniform data set which enables a quicker identification of potential issues or anomalies of the inspected AtoN.

Drones could also be used to enhance the heritage aspect of lighthouses and other AtoN structures, aligning with United Nations’ Sustainable Development Goal 11.4 to enhance sustainability.

# Scope

Within this guideline, the term 'Drone' refers to any remotely controlled Unmanned Vehicle (Aerial, Floating, Underwater) operated for AtoN management and hazard identification. These operations will include, but are not limited to:

* AtoN Installation
* AtoN Improvement
* AtoN Inspection
* AtoN Calibration

## dEsignation of roles

* Competent Authority: Maritime AtoN service provider
* Responsible Authority: Nominated authority within the organisation to oversee drone operations, administrative affairs, and oversee maintenance of drones. Provides guidance and supervision of Drone Pilots, and checks the qualification of Drone Pilot, and manages drone footage.
* Designated Drone Operator: Accountable for the safe conduct of the drone operations and ensuring that all operations comply with the relevant laws and regulations.
* Drone Pilot: The person who prepares the operation plan, does pre-operation checks, conduct the operation of drones (Certified Drone Pilot)
* Drone Maintenance Technician: The person who undertakes routine maintenance of drones
* National Regulator: National authority

In some organisations, one person may hold multiple roles.

# drone pilot

## dESIGNATION OF pilot

### Designation of pilot

To ensure safety of operation, the Responsible Authority should designate the Drone Pilot.

### Certification

As per relevant national legislation

## TRAINING

The Responsible Authority should ensure that training is provided to enable Drone Pilots to achieve and maintain the necessary levels required for drone pilot certification, etc. for:

* Operation of Drone
* Safe and efficient planning of the intended operation
* Maintenance of Drone and equipment
* National legislation updates
* Processing, analysis, and storage of data acquired

It is important for the Drone pilot to be familiar with national legislation and guidance, examples are available in Section 9 References.

# PURCHASE AND REGISTRATION

The Responsible Authority should consider operational efficiency and suitability when purchasing drones. For example waterproof drones. Each drone purchase should be reported to the Responsible Authority and registered as per national legislation requirements. The Responsible Authority should also ensure that appropriate insurance is in place, as per national legislation or guidelines.

# OPERATION OF DRONE

## PRE-operation check

Pre-operational checks should include notifying relevant entities within the operational areas if drone manoeuvres impact ship operations, VTS centres, and providing a preliminary notice to seafarers, if necessary, via Maritime Safety Information (MSI).

The Drone Pilot should regularly assess environmental factors, such as national parks, no-operation zones, restricted airspaces, and hazards, to ensure the safe operation of drones.

Additionally, the Drone Pilot should consider engaging with the local community and raising awareness of intended drone operations. They should also check local weather conditions, ensure a safe operating area, and address other environmental concerns such as nesting birds and noise pollution.

Furthermore, the Drone Pilot should check the drone recovery plan or procedure, considering weather conditions and the operation area.

## pre-operation inspection

The Drone Pilot should inspect drones according to the manufacturer’s instruction before operation.

These may include:

* Checking that the propellers are properly equipped and secured to the drone body.
* Ensuring that the batteries of drones and controllers are accurately fitted, have sufficient power, and are well connected with manoeuvring system. This is especially important to prepare for low-temperature situations such as rapid battery discharge.
* Verifying that the calibrations are correct and checking them each time the battery is replaced.
* Operating the drone after checking the radio controller’s channel access and First Person View (FPV) for interference.
* Checking the status of the drone body, cable, and connection for underwater use.

Operational aspects to consider include:

* The Responsible Authority conducting risk analysis.
* Drone Pilot checking to be flown is a radio interference area, such as Wi-Fi, and ensuring that satellite navigation (GNSS) signals are sufficiently received.
* Checking the solar flare activity and disturbance and refraining from flying if the magnetic field index is higher manufacturer instructions. However, in areas where wireless communication is not objectively possible, the magnetic field index check may be omitted.
* Checking for underwater obstacles through charts and considering weather conditions such as current, wind, and visibility.
* When operating drones in cold condition, considerations should include ice formation on propellers or wings, cold resistance of batteries, the effect of cold on drone structures and the remote pilot, and the effect of cold on the radio controller

## operational restriction

Drone Pilot should consider any threats to the safety of the pilot, nearby property, people and the drone itself.

When assessing operational restrictions for drones, the limitations set by the manufacturer of the drone should also be taken into consideration.

Assessment of factors such as wind, visibility, weather warnings, magnetic disturbance, etc., should be conducted.

Refer to Section 9 References for legislative examples.

## operational procedure

The Responsible Authority oversees and approves the operation of drones authorising the pilot to conduct the task while ensuring it is done safely.

The Drone Pilot risk assess situation in the operation area, allowing sufficient time to start and check for any abnormalities in the drones, as per the manufacturer’s instruction.

Operational performance limitations, such as take-off, landing, launching, and recovering of drones, shall comply with the manufacturer instructions for each type of drone.

Drone operations are not considered complete until the Drone Pilot delivers the acquired data to the Responsible Authority.

## procedure after operation

Drone usage may need to be recorded and reported to the Responsible Authority.

The Drone Pilot should complete the maintenance of drones after operations in accordance with the manufacturer’s instructions.

## approval of filming

The Drone Pilot should obtain permission to film from the applicable authorities, recognizing that the consenting body may differ depending on the location and privacy concerns. The pilot should be aware of national legislation for data protection and protecting people’s privacy. Consideration should be given to the audio and image range captured by the drones. It is important to respect other people’s privacy whenever operating drones.

# management of data acquired

## Data Storage & Access

The Responsible Authority should consider how to maintain the acquired data in an appropriate manner to ensure easy future access. They may need to consider data privacy requirements and the volume of data storage required.

The Responsible Authority could provide data access in accordance with national legislation (e.g., EU Privacy Protection Law). Data could be delivered to internal or external stakeholders such as Port Authority, Environmental entities, etc.

## Data protection

The Competent Authority shall be responsible for the protection of data acquired through drone operations, including metadata such as time and location. The Competent Authority shall also give consideration to cybersecurity measures to ensure the consistency and integrity of the data.

# maintenance of drone equipment

## oBLIGATION OF MAintenance

The Responsible Authority should ensure that a suitable maintenance programme has been put in place, and suitable processes are being followed by the Drone Pilot.

## PERIODIC INSPECTION

Drones should be inspected periodically like the examples below:

* Daily inspection: Conducted before and after the first use on the day of operation.
* Monthly inspection: Conducted once a month according to the manufacturer's maintenance instructions.
* Frequent inspection: Performance inspection conducted during maintenance, repair, or parts replacement.
* Special inspection: Conducted by an external company with professional personnel and inspection equipment if self-maintenance is not possible.

In addition, the Drone Maintenance Technician should conduct a comprehensive semi-annual inspection, including assessing the storage conditions of the drones, ensuring the availability of spare parts, and evaluating the overall operational status.

## FAILURE/DAMAGE/LOSS

Any failure, damage, or loss of drones should be recorded and reported to the Responsible Authority, the National Regulator, and other relevant bodies as required.

Plans and procedures should be prepared in the event of drone failure to minimize potential damage and increase the chance of recovery.

## DISposal

In cases where a drone becomes unusable due to the lapse of its durable years, damage, loss, etc., the matters should be reported to the Responsible Authority as required.

Drone or unusable parts should be disposed of in ethical and sustainable manner.

# Definition

Real-time kinematic (RTK) A satellite navigation technique used to enhance the precision of position data derived from satellite-based positioning systems(global navigation satellite systems, GNSS) such as GPS, BeiDou, GLONASS, Galileo and NavIC.

First Person View (FPV) Also known as remote-person view, or video piloting, a method used to control a [radio-controlled vehicle](https://en.wikipedia.org/wiki/Radio-controlled_vehicle) from the driver or pilot's viewpoint.

Drone operation Controlling drones and analysing data acquired, inspecting and maintaining drones and equipment

# references

* IALA Standard 1020 Marine Aids to Navigation Design and Delivery
* IALA Recommendation R1018 Responsible Design, Operation and Maintenance on the provision of Marine AtoN
* The Drone and Model Aircraft Code in UK(register-drones.caa.co.uk/drone-code)
* Korea Ministry of Oceans and Fisheries Unmanned Aerial Vehicle Guidelines (www.mof.go.kr)
* Federal Aviation Administration(faa.gov/uas)
* Australian Civil Aviation Safety Authority(casa.gov.au/knowyourdrone/drone-rules)
* Danish Civil Aviation and railway authority(droneregler.dk/english)
* CLASS N K Guidelines for ROV/AUV(www.classnk.or.jp)