

**Operations in the Maritime Environment**

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Nordic Unmanned ASA is a Norwegian RPAS operator founded in 2014 and owner of a LUC (EASA Light UAS Operator Certificate). It delivers flight services with a fleet of RPAS with a mass of 2 kg up to 200 kg in more than 20 countries. The company is listed on the Euronext stock exchange.

Our unique geographical situation in northern Europe, the experience of many of our staff in the domain of manned helicopter operations in the North Sea, and the number of employees with airline experience, provide a solid foundation to understand what it takes to be successful in delivering commercial RPAS operations in the maritime environment.

Below are some examples of RPAS missions, that have been carried out by Nordic Unmanned.



**Oil Spill Inspection**

Customer	European Union Organisation
In support of	Multiple EU maritime authorities
Maritime environment	National & international airspace
Deployment base	Oil spill emergency response vessels
RPAS used	Indigo 3 - Lockheed Martin, USA
Payload(s)	EO & IR
Operation:	
- Mission type:	VLOS & BVLOS
- Flight period:	Daytime
- Distance covered:	up to 20 km
- Quantity of flights:	Multiple
- Quantity days flown:	Multiple
Applicable regulation	EU Drone Regulation
Applicable rules	National & EU
Airspace integration	National authorities
ATM assured by	National ANSP



**Cargo Delivery To Offshore Platform**

Customer	Large Oil & Gas operator, Norway
Maritime environment	National & international waters
Cross Border Ops	No
Deployment base	Norway
RPAS used	S-100 - Schiebel, Austria
Payload(s)	EO & IR, cargo boxes
Operation:	
- Mission type:	BVLOS
- Flight period:	Daytime
- Distance covered:	>100 km
- Quantity of flights:	Multiple
- Quantity days flown:	Multiple
Applicable regulation	EU Drone Regulation
Applicable rules	National & EU
	- Customer safety rules
	- Customer emergency preparedness as part of Nordic Unmanned's ERP
Airspace integration	National, international
ATM assured by	Norwegian national ANSP



**Ship Emission Monitoring**

Customer	European Union Organisation
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In support of	Maritime authorities of various countries
Maritime environment	National and international waters
Cross Border Ops	Yes
Deployment base	Land based
RPAS used	S-100 - Schiebel, Austria
Payload(s)	EO & IR, emissions sensor
Operation:	
- Mission type:	BVLOS
- Flight period:	Day and night
- Quantity flights:	Multiple
- Quantity days flown:	Multiple
Applicable regulation	EU Drone Regulation
Applicable rules	National & EU
Airspace integration	National and international
ATM assured by	Various national ANSP



### Maritime Monitoring & Surveillance

Customer	European Union Organisation
In support of	Multiple countries
Maritime environment	National & international waters
Cross Border Ops	Yes
Deployment base	Various countries
RPAS used	Aerosonde - Textron Systems, USA
Payload(s)	EO & IR, SAR (Synthetic Aperture Radar)
Operation:	
- Mission type:	BVLOS
- Flight period:	Day and night
- Quantity flights:	Multiple
- Quantity days flown:	Multiple
Applicable regulation	EU Drone Regulation
Applicable rules	EU / National in various countries
Airspace integration	Cooperation between various countries
ATM assured by	Cooperation between various countries

### Semi-submersible Crane Vessel (SSCV) Inspection

Customer	Vessel operator
Maritime environment	Norwegian national waters
Cross Border Ops	No
Deployment base	Norway
RPAS used	Staaker, Nordic Unmanned, Norway
Payload(s)	EO & IR, LiDAR
Operation:	
- Mission type:	VLOS



- Flight period:	Daytime
- Quantity flights:	Multiple
- Quantity days flown:	Multiple
Applicable regulation	EU Drone Regulation
Applicable rules	National & EU
	- Customer safety rules
	- Customer emergency preparedness as part of Nordic Unmanned's ERP
Airspace integration	National Norwegian rules
ATM assured by	Norwegian national ANSP

### Challenges of Operations in Maritime Environments

Considerations in the following domains are of critical importance when planning maritime operations:

- Environmental Conditions
  - o Wind
    - High and gusty winds are more often present than during land-based operations requiring more accurate weather information and more robust RPAS.
  - o Humidity
    - High humidity, mostly saline and condensing, presents challenges to the design of the RPAS and increases the required maintenance and care to be provided to ensure continuous operations
  - o Temperature
    - Combined with high humidity and high wind, low temperatures will often create icing conditions that can compromise the safety of operations, if not detected or well managed.
  - o Visibility
    - The difference between temperature and Dew point is, more often than on land, very small and can create various types of fog that may remain in place for days at a time, affecting the visibility.
- Airspace (domestic and international)
  - o Maritime operations can be conducted in domestic airspace (within 12 nm of the coast), but also in international airspace
  - o Operations in international airspace that may also require flying across many borders and/or FIRs (Flight Information Regions), which requires that the operator masters regulations and operates in close cooperation with all stakeholders, especially during the planning of the activities.

- Other activities
  - Co-existence with other airspace activities (helicopter traffic)
  - Activities in maritime environments often involve big structures like oil & gas platforms that have specific constraints covering RPAS activities. Huge metallic structures with a high level of activities may cause magnetic interference, as well as radio interference, depending on what systems are active during the RPAS activities.
  - Various military activities, especially above water bodies under international airspace, will affect maritime RPAS operations in many ways.
- Endurance
  - Maritime operations typically involve long flights. Possibilities for a refuelling and/or battery recharging stop on the way are very limited.
  - In the case of an impossibility to make it back to a safe landing area, at sea or on land, the options to interrupt a flight are typically limited to “safely” ditching the RPAS and its payloads in the water. This is an expensive and not very environmental-friendly option, which should be avoided.
- Reliability
  - As for endurance, reliability is critical to ensure we can fly assets up to their expected life duration.
- Customer Requirements
  - Maritime environment customers are used to work with commercial helicopter operators and have implemented over the years very effective processes and rules to ensure all stakeholders are cooperating effectively.
  - Introducing RPAS services requires substantial knowledge of the customer’s activities (e.g. oil & gas industry, surveillance authorities), especially their specific regulatory frameworks in various countries and regions of the world.
  - Customers will typically require that the RPAS and the RPAS operator demonstrate a high number of hours of operation in a similar maritime environment, before allowing any RPAS activities to take place.
- Adhering to the customer’s safety approach in it’s field of activity and the applicable regulation is essential, in addition to adhering to the RPAS specific safety management, in order to have a complete picture of all potential risks and mitigations.
- Applying the SORA methodology is only an element of the safety management of RPAS operations in the maritime environment; it is complemented by other requirements (not only related to aviation), that need to add to our safety assessment.
- Emergency readiness includes not only the RPAS operator’s Emergency Response Plan (ERP), but also its integration with our customer’s emergency preparedness activities, which are typically more elaborated.

### **Experience in Managing Aviation Activities**

- In all our deployments and discussions with customers and regulatory authorities, we saw the importance of having a deep understanding of all aviation related topics that go beyond the RPAS domain, in order to be able to effectively supply our RPAS services.
- These topics cover among others: airspace structure and management, procedures before, during and after flights, payload operations, understanding manned aviation rules and procedures, radio frequency coordination, crew training and scheduling, transport of dangerous goods, management of long term deployments, maintenance planning and execution, emergency preparedness, and all of those in multi-country deployment scenarios.
- Managing aviation activities means being expert in managing exceptions and unplanned events. This capability becomes even more important in maritime commercial activities, as it makes the difference between a successful and profitable operations and an interrupted service, that will not meet the customer’s expectations.

### **Teamwork**

- Aviation learns from sharing experience and maritime environment operations are not different.
- Nordic Unmanned’s experience shows that all stakeholders are willing to work together and make RPAS services introduction in maritime environment a safe and successful activity for all parties involved.

### **Safety First**

- Operations in maritime environments are always required to put safety as a first priority in all phases of the flight missions.



## Conclusion

In conclusion, RPAS operations in the maritime environment have specific challenges and a lot of experience and aviation expertise is required from the RPAS operator in order to achieve successful deployments. If flying prototypes and low maturity systems may be acceptable for some land-based operations, it is definitely not suitable for commercial RPAS services in the demanding maritime environment.

Nordic Unmanned has acquired a unique international experience in maritime operations and we are continuously expanding the types of services we are offering and delivering to our customers.

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## Examples of other drone missions conducted by Nordic Unmanned

### Blood Transport



### Sub-surface Mapping



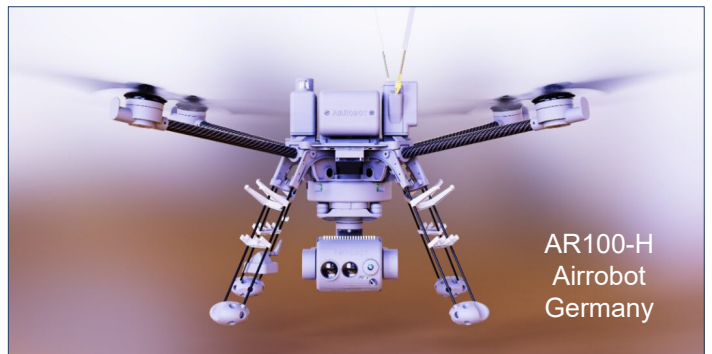
### Railway Track Inspection



### Bridge Inspection



### Security-related Operations



### Perimetric & Industrial Site Monitoring

