Operator’s Logo (if applicable)

**<Operator Name>**

**UAS Operations Procedures**

**Document No.: <Reference No.>**

**Revision: <No.>**

**<Operator Unique Entity Number>**

**<Operator Address>**

**<Operator Contact Details>**

|  |  |  |  |
| --- | --- | --- | --- |
| **Approved by:** |  | **Date:** |  |
|  | *(Name / Designation / Signature)* |  | *(DD / MMM / YYYY)* |

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## **Record of Revisions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision** | **Date of Revision** | **Page / Section** | **Purpose of Revision** |
| 0 | 10 Jun 2015 | All | Initial release |
| 1 | 19 Sep 2015 | p.8 / s.1.3 | Included additional responsibilities for the Operator |
| 2 | 23 Oct 2016 | p.10 - 12 / s.2 | Included XXX |
| p.19 / App. C | Revised XYZ |
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## **Foreword**

The Operations Procedures contains instructions for the operation and management of UAS and all personnel critical to the safety of UA operation who are controlled under the authority of the UA Operator Permit.

Any changes to the Operations Procedures, other than typographical errors or changes that do not affect the meaning of the content, must be notified to and accepted by CAAS.

## **Acronyms, Abbreviations and Definitions**

**List of Definitions**

|  |  |
| --- | --- |
| ***“Empty Mass”*** | refers to mass of UA without payload. |
| ***“Maximum Take-off Mass”*** | refers to maximum mass at which the UA can take-off, due to structural or other limits by design. |
| ***“Maximum Flight Duration Capable”*** | refers to flight duration capable based on UA design and empty mass configuration. |
| ***“Maximum Speed Capable”*** | refers to maximum speed capable based on UA design. |
| ***“Maximum Height Capable”*** | refers to maximum height capable based on UA design. |

**List of Acronyms and Abbreviations**

|  |  |
| --- | --- |
| ***CAAS*** | Civil Aviation Authority of Singapore |
| ***GCS*** | Ground Control System |
| ***UA*** | Unmanned Aircraft |
| ***UAS*** | Unmanned Aircraft System |
| ***UAPL***  | Unmanned Aircraft Pilot Licence |

# **Section 1 – Organisation Operations**

## **1.1 Organisation Profile**

<Operator’s input…>

## **1.2 Organisational Structure**

## **1.3 Responsibilities of the Operator**

The Operator is accountable for the overall compliance of safety requirements and ensuring that adequate resources are available to conduct the operations in accordance to the Operations Procedures, to support the scope and conditions in the UA Permit.

The Operator’s responsibilities include:

* Providing and allocating manpower, technical, financial or other resources necessary for effective safety compliance;
* Establishing and monitoring of safety performance, and resolution of any safety issues;
* Ensuring all UA activities are conducted with the necessary permits granted by the relevant authorities, and in compliance with the conditions listed in the permits;
* Maintaining all records, such as flight logs, maintenance logs, UA configuration management and UA operation personnel’s training records;
* Ensuring all UA pilots and any personnel involve in the UA operations are proficient, qualified, familiar with and implement the procedures set out in the Operations Procedures;
* Ensuring that the Operations Procedures is complete, relevant and up-to-date;
* Coordinating and communicating with CAAS and other Singapore government agencies on issues relating to safety, any changes to the organisation structure, as well as any enquires pertaining to UA permit application, or general regulatory matters.

# **Section 2 – Incident/Accident Reporting**

## **2.1 Reporting Requirements**

The Operator shall inform CAAS UAS Duty Officer (Tel: +65 9830 6418) of any airworthiness or operational incident/accident, as defined by the Air Navigation (Investigation of Accidents and Incidents) order, relating to the UA within 24 hours of its occurrence, and follow up with a written report within 3 working days to CAAS\_UAS@caas.gov.sg.

The initial notification shall include, but not limited to the following:

* Permit details (such as Operator Permit number, Activity Permit number etc.)
* Date, time and location of the incident/accident
* Casualty and damaged property Involved
* Details on UA used and state of UA
* Details of UA Pilot involved
* Initial analysis to the cause of incident/accident
* Immediate action taken after the incident/accident

The written report shall include, but not limited to the following:

* Information provided in the initial notification to CAAS
* Investigation outcome
* Root cause analysis / causal factors analysis
* Corrective / preventive actions taken to prevent a recurrence

A template of the written report (i.e. Incident/Accident Reporting Form) is shown in **Appendix C**.

## **2.2 Management of Casualties**

In the event of an UA incident or accident resulting in casualties, all personnel involved in the UA operations shall follow the casualty management plan as set out in the following:

* The UA Pilot shall stop the UA operation as soon as practicable and attend to the casualty immediately.
* For minor injuries, first aid shall be administered to the casualty and …
* For serious injuries, the casualty shall be transported to the nearest identified hospital and …

Useful Contacts:

|  |  |
| --- | --- |
| AMBULANCE | 995 |
| POLICE | 999 |
| FIRE | 995 |
| … | +65 XXX |

# **Section 3 – Internal Training**

## **3.1 Internal Training Requirements**

All personnel working under the authority of the Operator Permit shall complete the following internal training relevant to their scope of work before they are allowed to work independently. Only the personnel nominated by the Operator are permitted to provide the relevant trainings.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/N** | **Name of Training** | **Training Type** | **Pre-requisites / Qualifications** | **Recurrent Required?** |
| 1 | Familiarisation of operator’s procedures & processes | Briefing | Nil | Annually |
| 2 | Understanding of individual’s job functions, scope & responsibilities | Briefing | Nil | No |
| 3 | [UA Type]-specific training* Operational capabilities, specifications & limitations
* Normal & emergency operating procedures
* Maintenance procedures
 | Workshop / OJT (X times) | [Name of Training] Completed /Valid UAPL | Annually |
| 4 | [Type of Operations]-specific training* Scenario-based operating procedures & contingencies
 | Workshop / OJT (X times) | [Name of Training] Completed /Valid UAPL | Monthly |

## **3.2 UA Pilot Currency Requirements**

All UA pilots shall minimally hold a valid UAPL with the relevant rating(s), and maintain their operational currency in accordance with the following currency management plan.

|  |  |  |
| --- | --- | --- |
| **UA Category / Type** | **No. of sorties required per year** | **Corrective Actions for Non-Current UA Pilots** |
| Rotorcraft | 2 | [Name of Training] to be completed again |
| Aeroplane | 2 | X satisfactory supervised flights by a current UAPL holder |
| Powered-Lift | X | XXX |
| Airship | X | XXX |

All UA pilots working under the authority of the Operator Permit shall be tracked throughout the Operator Permit’s validity, and the template is shown in **Appendix B**.

# **Section 4 – Management of Records**

## **4.1 Management of Flight Logs**

All flights conducted shall be recorded in a Flight Logbook for the purpose of tracking UA pilots’ flying hours and equipment running hours. The records shall be kept minimally for a period of 1 year.

Flight details to be recorded in the Flight Logbook includes:

* Date, time and duration of flight
* Location of flight
* Purpose of flight
* UA configuration used for flight
* UA pilot(s)-in-command

A template of the Flight Logbook is shown in **Appendix D**.

## **4.2 Management of Maintenance Logs**

All maintenance conducted on the UA, either scheduled or unscheduled, shall be recorded in a Maintenance Logbook. Each UA shall have its dedicated logbook to track its configuration. The logs shall be kept minimally for a period of 1 year upon decommissioning of the respective UA.

The Maintenance Logbook shall be divided into following sections:

1. Configuration Management –

The part number and serial number of all installed components on the UA, which the Operator can readily replace during maintenance, shall be tracked in this section.

1. Maintenance / Defects Log –

The purpose and date of maintenance, name of personnel conducting the maintenance, description of defects found and description of rectifications conducted shall be recorded in this section. All critical defects shall be rectified before the UA is allowed to be operated.

A template of the Maintenance Logbook is shown in **Appendix E**.

## **4.3 Management of Training Logs**

All trainings related to the safe operations or maintenance of the UAS attended by personnel working under the authority of the Operator Permit shall be recorded in a Training Logbook. Each personnel shall have a personal Training Logbook. The logs shall be kept for a period of 1 year upon the respective personnel’s last day of service in the organisation.

Training details to be recorded in the Training Logbook includes:

* Name and type of training
* Purpose of training
* Date of training completed

A template of the Training Logbook is shown in **Appendix F**.

# **Section 5 – Unmanned Aircraft Type**

## **5.1 UA Brand / Type 1**

### **5.1.1 UA Configuration List**

|  |
| --- |
| <Picture(s) of UA configuration, showing clearly the UA and payload(s) installed.> |
| **Configuration Name** | UA Config 1 |
| **Configuration Weight**  | 2.0 kg |
| **Power Source** | Onboard Lithium Polymer batteries |
| **Payload 1 Brand / Model** | Zenmuse 3-axis Gimbal |
| **Payload 2 Brand / Model** | Zenmuse Z5 Camera |

|  |
| --- |
| <Picture(s) of UA configuration, showing clearly the UA and payload(s) installed.> |
| **Configuration Name** | UA Config 2 |
| **Configuration Weight**  | 1.9 kg |
| **Power Source** | Ground power via tether system. Onboard batteries removed. |
| **Payload 1 Brand / Model** | Zenmuse Lidar |

### **5.1.2 UAS Specifications**

|  |  |
| --- | --- |
| **UA Brand / Model / Name:** |  |
| **Dimensions:** | **Empty Mass:** |  | **kg** |
| **Maximum Take-off Mass:** |  | **kg** |
| **Length:** |  | **m** |
| **Wingspan:** |  | **m** |
| **Maximum Flight Duration Capable:** |  | **minutes** |
| **Maximum Speed Capable:** |  | **m/s** |
| **Maximum Height Capable:** |  | **ft** |
| **Power Source:**  |  |
| **Radio Frequency Band(s):** |  | **GHz** |
| **Radio Frequency Field Strength/Power:** |  | **mW ERP/EIRP** |

|  |  |
| --- | --- |
| **Payload Brand / Model / Name:** |  |
| **Payload Type / Description:** |  |
| **Mass:** |  | **kg** |
| **Specifications 1:** |  |  |
| **Specifications 2:** |  |  |
| **Specifications 3:** |  |  |

|  |  |
| --- | --- |
| **GCS Brand / Model / Name:** |  |
| **GCS Description:** |  |
| **Specifications 1:** |  |  |
| **Specifications 2:** |  |  |
| **Specifications 3:** |  |  |

### **5.1.3 Flight Procedures**

#### **5.1.3.1 Flight Checks**

Flight checks for the above listed UA configurations shall be conducted in accordance with the manufacturer’s instructions, as stated in the following table.

|  |  |  |
| --- | --- | --- |
| **Document Title** | **Revision No. / Date** | **Referenced Section / Page** |
| DJI Phantom XX Advanced User Manual | V2.0 2016.3 | Section – Flight, pg XX – YY |
| DJI Phantom XX Pro User Manual | V1.0 2017.5 | Section 5, pg XX – YY |

#### **5.1.3.2 Emergency Procedures**

|  |  |
| --- | --- |
| **Emergency** | **Procedures** |
| Loss of UA control / UA flyaway | 1. For this scenario, the UA pilot shall continuously attempt to regain control by either adjusting the transmitter antenna or move closer to the UA.
2. If control is not regained after X seconds, and the UA does not automatically return to its take-off point or land on the spot, it means that this is not the case of a control link loss.
3. The UA pilot shall continue all means to regain control or take down the UA, and alert the Authority of the incident.
 |
| Loss of UA power / UA low battery | 1. Upon reaching XX% of battery health, the UA pilot will be alerted via the GCS, he shall then land the UA at the designated landing area.
2. Upon reaching YY% of battery health, the UA will override the UA pilot control and automatically return to take-off point.
3. If there is a loss of GPS signal during this flight phase, UA will automatically land on the spot.
4. For this scenario, the UA pilot shall ensure that there are nobody within the vicinity of the landing area.
 |
| Loss of control link with UA | 1. Upon loss of control link with UA, UA pilot shall attempt to regain control by either adjusting the transmitter antenna or move closer to the UA.
2. If link is not regained after X seconds, the UA will automatically return to take-off point.
3. If there is also a loss of GPS signal, the UA will automatically land on the spot, instead of returning to take-off point.
4. The UA pilot shall ensure that there are nobody within the vicinity of the landing area.
 |
| Loss of positioning capabilities | 1. Upon loss of GPS signal, UA will automatically switch to its XXX system to maintain its position.
2. UA pilot shall, as soon as practicable, attempt to land the UA in a safe location.
3. If both GPS signal is loss and the XXX System is faulty, UA pilot shall switch to “manual” mode and attempt to land the UA in a safe location.
 |

### **5.1.4 Maintenance Plan**

Maintenance for the above listed UA configurations will be conducted in accordance with the manufacturer’s instructions, as stated in the following table.

|  |  |  |
| --- | --- | --- |
| **Document Title** | **Revision No. / Date** | **Referenced Section / Page** |
| DJI Phantom XX Maintenance Manual | Revision 3.0 2017.5 | All |

# **Section 6 – UA Operations**

## **6.1 Type of Operations 1**

### **6.1.1 Description of Type of Operations 1**

<Operator’s input…>

### **6.1.2 General UA Operating Procedures**

<Operator’s input…>

### **6.1.3 Hazard Identification, Risk Assessment and Risk Mitigation**

The preliminary risk assessment for Type of Operations 1 is shown in **Appendix G**.

# **Appendix A – List of UA Types and Allowable Types of Operation**

|  |  |
| --- | --- |
| **UA Type** | DJI Phantom 3 series |
| **UA Category** | Rotorcraft |
| **Maximum Take-off Mass** | 1.5 kg |
| **Allowable Type of Operations** | 1. Aerial Photography / Videography
2. Conduct of training involving flying / operating of UA
3. Fight Demonstration
 |
| **Special Authorisation** | Nil |

|  |  |
| --- | --- |
| **UA Type** | Proprietary Custom Mark III  |
| **UA Category** | Powered-Lift |
| **Maximum Take-off Mass** | 20.0 kg |
| **Allowable Type of Operations** | 1. Flight Test
2. Delivery / Carriage of Items
 |
| **Special Authorisation** | **BVLOS Risk Level** | Low / Medium / High |
| **Area of Operations** | ABC Road, One North Park |
| **Compliance Checklist** | XXX-01 Rev. 1 – BVLOS Compliance Matrix |
| **Limitations** | Limited to operation during off-peak hours. |
| **Flight Plan**<Insert picture(s) of flight plan(s)> |

# **Appendix B – List of UA Pilots Template**

|  |  |  |  |
| --- | --- | --- | --- |
| **S/N** | **Name of UA Pilot** | **UAPL No.** | **Licence Rating(s)** |
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# **Appendix C – Incident / Accident Reporting Form**

The Operator shall inform CAAS at CAAS\_UAS@caas.gov.sg of any airworthiness or operational incident/accident, as defined by the Air Navigation (Investigation of Accidents and Incidents) order, relating to the UA with a written report within 3 working days.

**Part 1: General Details**

|  |  |  |  |
| --- | --- | --- | --- |
| **Occurrence Date:** | Click or tap to enter a date. | **Occurrence Time:** | (HH:MM) |
| **Operator:** | Organisation Name | **UOP Number:** | UOP/0XXX | **AP Number:** | AP1/xxxxxxxx/000x/UOP/0xxx |
| **Pilot (1) Name:** | Click or tap here to enter text. | **Pilot (2)/Trainee Name (If applicable):** | Click or tap here to enter text. |
| **UAPL number:** | Click or tap here to enter text. | **UAPL Number (if applicable):** | Click or tap here to enter text. |
| **UA Type:** | Brand/Model. |
| **UA Registration Number:** | AAXXXXX |
| **Type of Operations:** |[ ]  Training  |[ ]  Flight Test/Trial  |[ ]  Demo  |[ ]  Competition  |
|  |[ ]  Photography/Videography  |[ ]  Parcel Delivery |[ ]  Others:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Specify) |
| **Location:** | Click or tap here to enter text. |

**Part 2: Occurrence Details**

|  |
| --- |
| **Occurrence Summary** |
| Description of the Accident or Incident (Provide supplementary documents if necessary) |
| **Injuries to Personnel** |[ ]  Yes  | **Damage to Property** |[ ]  Yes  | **Damage to Aircraft** |[ ]  Yes  |
|  |[ ]  No  |  |[ ]  No  |  |[ ]  No  |
| **Details, if Yes** | **Details, if Yes** | **Details, if Yes** |
| Click or tap here to enter text. | Click or tap here to enter text. | Click or tap here to enter text. |

**Part 3: Causal Factors and Actions Taken**

|  |  |  |
| --- | --- | --- |
| **Initial analysis to the cause of incident/accident**  |[ ]  Machine (Flight Critical Component) |[ ]  Machine (Non-Flight Critical Component) |
|  |[ ]  Man |
|  |[ ]  Others: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (to specify) |
| **Description of Initial Analysis** |
| Describe the initial analysis of causal factor (Provide supplementary documents if necessary) |
| **Initial Containment, Corrective and/or Preventive Actions to Prevent Reoccurrence**  |
| Describe actions taken to contain the accidents/incident until further investigation and to prevent future accident/incident (Provide supplementary documents if necessary) |

# **Appendix D – Flight Logbook Template**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Date**(DD/MM/YY) | **Time**(HH:MM) | **Duration**(min) | **Location of Flight** | **Purpose of Flight** | **UA S/N** | **Battery S/N** | **Payload S/N** | **UA Pilot in Command** |
|  |  |  |  |  |  |  |  |  |
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# **Appendix E – Maintenance Logbook Template**

**Configuration Management**

|  |
| --- |
| **UA Type:** **Registration ID:** **Date of Commission:**  |
| **Component Description** | **Part No.** | **Serial No.** |  | **Component Description** | **Part No.** | **Serial No.** |
|  |  |  |  |  |  |
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**Defects / Maintenance Log**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Date Conducted****(DD/MM/YY)** | **Purpose** **(Scheduled/Unscheduled)** | **Description of Defects Found** | **Description of Rectification Conducted** | **Conducted By** **(Initials/Signature)** |
|  |  |  |  |  |
|  |  |  |  |  |
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# **Appendix F – Training Records Template**

|  |
| --- |
| **Staff’s Particulars****Name:****NRIC:****Designation:****Date Joined:** |
| **No.** | **Name of Training** | **Type of Training**(OJT, Workshop, Course, Seminar, Briefing etc.) | **Purpose of Training**(Induction, Recurrent, Competency Development etc.) | **Date Completed**(DD/MM/YY) | **Remarks** |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
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# **Appendix G – Risk Assessment**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S/N** | **Hazard** | **Phase(s) of Flight** | **Consequence(s)** | **Causal Factor(s)** | **Risk before Mitigations** | **Control / Recovery Measures** | **Risk after Mitigations** |
| **Section A: Risk Assessment for Type of Operations 1** |
| 1 | Accidental Flying into restricted airspace | Take-off, Mid-flight, Approach, Landing | Collision with manned aircraft | Lapse in active monitoring of UA’s position / altitude / heading | Remote x Catastrophic = High | Consider people, machine & environmentPilot must actively monitor UA flight parameters & maintain UA within stipulated area of ops.Ensure continuous radio link between UAS operator & UA throughout flying phase.Monitor wind speed in area of ops. Terminate UA flying when wind speed excess stipulated limits. | Extremely Remote x Catastrophic = Medium |
| x | xx | xx | xx | xx | xx | xx | xx |
| **Section B: Risk Assessment for Area of Operations** |
| 1 | Built-up areas in the vicinity of the area of operations | Mid-flight | UA collides with building & crashes on nearby people and/or neighbouring building(s). | Loss of visual line of sight between UA & operator | Extremely Remote x Catastrophic = Medium | Consider people, machine & environmentPilot must maintain visual contact with UA at all times.Operate UAS within published radio range.Maintain safe distance from public roads, buildings and personnel. | Extremely Improbable x Catastrophic = Low |
| x | xx | xx | xx | xx | xx | xx | xx |

|  |  |
| --- | --- |
| **Risk Probability**Either qualitative or quantitative assessment | **Risk Severity** |
| **Catastrophic** | **Hazardous** | **Major** | **Minor** | **No effect** |
| **Probable***Anticipate to occur >=1x during the entire system/operational life of an item; or* *Once in 1000 to 10,000 (hrs)* | **High** | **High** | **Medium** | **Low** | **Low** |
| **Remote***Unlikely to occur to each item during its total life. May occur several times in the life of an entire system or fleet; or* *Once in 10,000 to 100,000 (hrs)*  | **High** | **High** | **Medium** | **Low** | **Low** |
| **Extremely Remote***Not anticipated to occur to each item during its total life. May occur a few times in the lift of an entire system or fleet; or**Once in 100,000 to 1,000,000 (hrs)* | **Medium** | **Medium** | **Medium** | **Low** | **Low** |
| **Extremely Improbable***It is not anticipated to occur during the entire operational life of an entire system or fleet; or**Below once in 1,000,000 (hrs)* | **Low** | **Low** | **Low** | **Low** | **Low** |
| **Failure Condition in a UAS:**A condition having an effect on the UAS, either direct of consequential, which is caused or contributed to by one or more failures or errors considering flight phase and relevant adverse operational or environmental conditions or external events**Catastrophic**: Failure would prevent continued safe flight and landing resulting in (a) one or more fatalities or serious injury to persons or major property damage external to the UAS, (b) uncontrolled loss of aircraft **Hazardous:** Failure would reduce the capability of the aircraft or the ability of the crew to cope with adverse operating conditions to the extent that there would be the following:1. Physical distress to persons or property damage external to the UAS possibly including injuries
2. A large reduction in safety margins or functional capabilities
3. Higher workload such that the flight crew cannot be relied upon to perform their tasks accurately or completely.

**Major:** Failure would reduce the capability of the aircraft or the ability of the crew to cope with adverse operating conditions to the extent that there would be1. Potential for physical discomfort to persons or minor property damage external to UAS
2. A significant reduction in safety margin or functional capabilities
3. A significant increase in crew workload or in conditions impairing crew efficiency

**Minor:** Failure would not significantly reduce the aircraft safety and involve crew actions that are well within their capabilities. It may include slight reduction in safety margins or functional capabilities, slight increase in crew workload (e.g. routine flight plan change)**No effect:** Failure would have no effect on safety, i.e., operational capability of the aircraft or increase workload of the crew **Risk Level (after minimising procedures taken into account)****H** – High, **M** – Medium, **L** –Low |