FLIGHT SAFETY FOUNDATION

independent • impartial • international

Basic Aviation Risk Standard

Remotely Piloted Aircraft Systems





Version 3, October 2020

Courtesy Northrop Grumman

Contents

Purpose

This Standard provides companies with a minimum control framework for risk-based management of Remotely Piloted Aircraft Systems (RPAS) operations.

All national and international regulations pertaining to RPAS operations must be followed. This Standard is designed to supplement those requirements.

Document Structure

The Standard is presented in a risk-based format to emphasize the relationship between threats to safe RPAS operations, associated controls and applicable recovery/mitigation measures. The bow tie presentation of all threats and controls is illustrated in Figure 1.

The format is intended to assist all personnel associated with RPAS operations in the management of all associated risks to their activity. Importantly, the design encourages further risk assessment as the level of complexity of the activity increases. The appendices attached to this standard outline additional controls and risk assessment considerations for the increasing levels of complexity.

Each BARS control and defence has been provided with a **Safety Goal** to assist users of the BAR Standard to identify the purpose of the control or defence and a pathway towards creating a performance indicator to measure the effectiveness of the organization in achieving a desired level of safety performance.

Change bars have been utilized to indicate material changes to the content or intent of the Standard.

Governance Model

The purpose of introducing a governance model is to ensure the introduction of a new risk, such as RPA activities into an existing company's operation, is managed with the same rigour as other material risks from the outset.

A suggested format for governance of RPAS supporting company or emergency service use is presented in Appendix 1. This model is intended to be fit-for-purpose, and in a format that can be adapted to any organization's structure and operating model. Additional examples as to how different organizations manage their governance surrounding RPAS usage can be obtained from the Flight Safety Foundation BARS Program Office (BPO).

As part of the governance process, certain RPAS activities based on their level of complexity will require the organization's internal approval of RPAS operators. Audits will be done to a protocol derived from the BARS RPAS Question Master List, the BARS RPAS standard and other referenced industry accepted RPAS standards.

Variations

Any variation to this Standard is at the discretion of each organization. It is recommended that each variation be assessed to demonstrate that the risks associated with the variation are tolerable and justify safe continuation of operations.

Standard Operating Conditions

Operation of one RPA per Remote Pilot at any one time. Maintaining Visual Line of Sight (VLOS) during day operations and below 400 feet Above Ground Level (AGL). Not to be operated closer than 30 meters to personnel who are not associated with the flight. Not to be flown over populous areas and/or personnel in the area of operation. Not to be flown within 3 nautical miles (nm) of any aerodrome*, and to remain outside all active prohibited and restricted areas.

**for Resource Sector activities at uncontrolled aerodromes/ HLS, permission must be obtained from the aerodrome/HLS operator.*

Figure 1: BARS Bow Tie Risk Model – Schematic of Remotely Piloted Aircraft Systems Management

Version 3, October 2020

Controls and Recovery Measures.

RPAS Accident

Recovery Measures:

Engine Failure

Emergency Equipment

Emergency Response Plan

Insurance

Incorporation of Research and Development Outcomes

Public Relations

Investigation Procedures

BARS® BASIC AVIATION RISK STANDARD
FLIGHT SAFETY FOUNDATION

Version 3, October 2020

All Threats 1.0: Common Controls

These controls apply to all threats in the RPAS Standard

Common Control 1.1: Pilot Qualifications, Recency and Experience

Ensuring pilot is competent to fulfill their duties by having appropriate training, qualifications and experience.

All Remote Pilots (RP) must meet the qualification requirements listed in Appendix 2.

Each RP must also be assessed for operational capability by an established Check and Training protocol that is clearly documented. Where available, appropriate simulation facilities that have been validated as being acceptable by either the responsible regulatory authority or company representative may be used for both training and currency purposes.

Common Control 1.2: Regulatory Approval

Ensuring RPAS operations have local regulatory authority approval.

RPAS operations must be conducted in accordance with the local regulatory framework and, where applicable, within the provisions of the operating certificate issued by the National Aviation Authority (NAA).

Common Control 1.3: Airworthiness Approval

Ensuring the RPA achieves acceptable standards of airworthiness.

All RPA must be issued with a current certificate of airworthiness if required by the NAA. Regardless of size and type, all RPA should have a system of airworthiness control in place that considers whether the RPA can meet minimum safety performance standards.

Common Control 1.4: Safety Management System

Ensuring Safety Management Systems are effective at gathering and analyzing safety information, managing risk, providing assurance and ensuring continuous improvement.

All RPAS operations must be supported by an integrated Safety Management System that includes use of Operational Risk Assessments (ORAs) for all tasks and activities and an incident reporting system that provides analysis and improvement opportunities.

Common Control 1.5: Operational Risk Assessment (ORA)

Ensuring all risks associated with aircraft operations are analyzed, minimized and accepted.

RPAS operators must conduct a risk assessment, including the identification and implementation of mitigation controls, before commencing any operation. A guide to areas to be included in a basic ORA is presented in Appendix 3.

Common Control 1.6: Drug and Alcohol Program

Ensuring all safety critical personnel are fit-for-work at all times.

The RPAS operator must have a Drug and Alcohol Policy which meets all requirements of the NAA. Where no such regulatory requirements exist the operator must, at a minimum, meet the requirements of the contracting company.

Common Control 1.7: Fatigue Management

Ensuring flight crew are not impacted by fatigue.

The RPAS operator must have a Fatigue Management Plan in place that considers the workload for the Remote Pilot (RP) in addition to other members of the RPAS operations team. The Fatigue Management Plan must be endorsed by the contracting company and where necessary meets or exceeds the requirements of the NAA.

Common Control 1.8: Approval Framework

Ensuring application of a governance framework and the use of licenced and approved operators.

The RPA Operator (internal to the company or externally contracted) must have a valid and approved Remote Operating Certificate (ROC) under the following situations:

- Very small and small RPA activities conducted under non-Standard Operating Conditions; and
- All medium and heavy RPA activities.

Common Control 1.9: Equipment Standard

Ensuring aircraft are fitted with the required minimum level of equipment suitable for the intended operations.

RPAS must be designed to minimize the potential for a failure of any component that will prevent continued safe flight and/or recovery of the vehicle. Where parachutes integral to the unit are available for the category of RPA used, consideration for their use should be reviewed.

Include a minimum IP rating for the required RPAS operation in the ORA to consider the risk associated with ingress of solid objects and ingress of liquids into RPAS system and components.

Common Control 1.10: Operations Manual

Ensuring clearly defined operating procedures are in place.

Each RPAS Operator must have a published Operations Manual that meets the requirements of the NAA and includes detail on how training, operations and maintenance are conducted.

Common Control 1.11: Human Factors

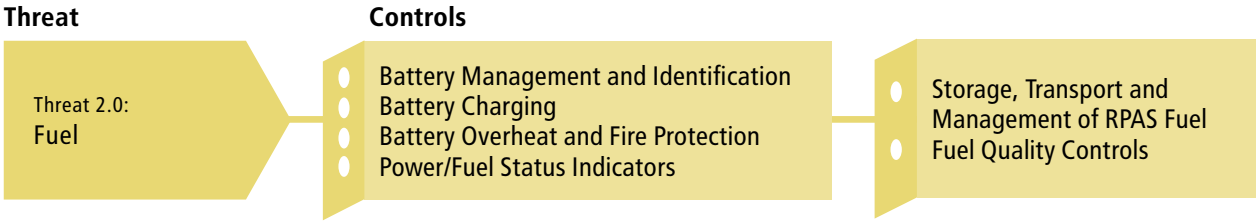
Ensuring RPAS operator considers the Human Factors element in the operations.

Each RPAS operator must have a system to consider the Human Factors element of design, operations and maintenance. Considerations include:

- Task priorities, including dealing with client requests;
- Communications between pilot and observer (as required);
- The employment of Sterile Cockpit procedures;
- Threat and Error Management;
- Crew Resource Management;
- Ergonomics of control systems and their design; and
- Spatial Disorientation as it pertains to RPAS orientation issues.

Threat 2.0: Fuel

A remotely piloted aircraft conducts a forced landing or ditching as a result of fuel mismanagement resulting in an accident



Control 2.1: Battery Management and Identification

Ensuring RPAS batteries are identified and controlled.

All RPAS batteries must be identified by model and serial number and must be controlled and managed under a documented procedure.

Control 2.2: Battery Charging

Ensuring eliminate the risk of fire associated with battery handling.

All RPAS batteries must be charged in accordance with manufacturer's recommendations and be protected from an overcharging event.

Control 2.3: Battery Overheat and Fire Protection

Ensuring eliminate the risk of fire associated with battery handling.

All batteries must be equipped with an appropriate mechanism to reduce or eliminate the risk of overheating and fire.

Control 2.4: Power/Fuel Status Indicators

Ensuring limit the risk of control system or propulsion failure due to loss of power.

Battery powered RPA must be equipped with power supply status indicators that provide adequate notification to the operator of the power state and warnings when a low power level is approaching.

Hydrocarbon powered RPA must be equipped with a fuel quantity indication system that provides adequate notification to the operator of the fuel state and warnings when a low fuel level is approaching.

The GCS must also provide the Remote Pilot with an indication of power status and warnings when a low power level is approaching. Consideration should be given to the inclusion of an Uninterrupted Power Supply for the GCS when long duration flights are planned.

The low power indications or low fuel warnings must provide the RP with sufficient notification to safely recover the RPA.

Flights shall be planned/managed to ensure the RPA has sufficient battery/fuel available to enable a safe return to the home location taking into account weather conditions - specifically wind direction and strength.

Control 2.5: Storage, Transport and Management of RPAS Fuel

Ensuring the safe transport of dangerous goods associated with RPAS operations.

RPAS power supplies must be stored, transported and managed in accordance with governing environmental and Dangerous Goods requirements.

Batteries and hydrocarbon fuel must be stored in fire proof stores as required by OHS requirements - bunding to be included for liquids in the event of leakage.

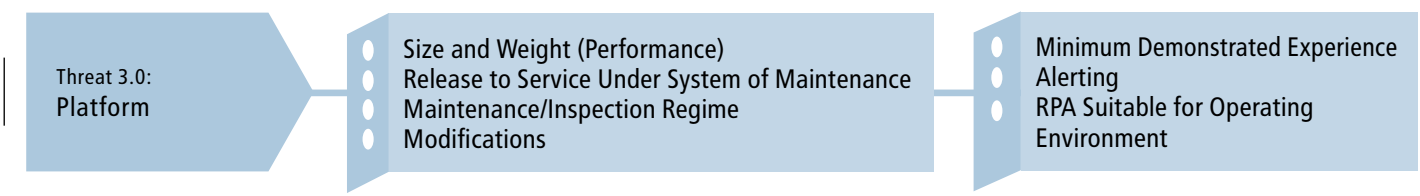
Control 2.6: Fuel Quality Controls

Ensuring the safety and quality of RPAS fuel supplies.

If the RPAS is not powered by battery, then hydrocarbon supplies must be managed in accordance with standard aviation fuel management procedures that address storage, testing and filtration.

Threat 3.0: Platform

The remotely piloted aircraft exceeds its design limitations resulting in an accident



Control 3.1: Size and Weight (Performance)

Ensuring RPA capability and performance in different operational ambient conditions.

The RPAS operator must ensure that the RPA is capable of operating in the ambient conditions. Considerations include altitude, temperature, wind, visibility, cloud, the size of obstacles surrounding the area designated for takeoff/landing and the surface integrity such as dust, sand or swamp.

Control 3.2: Release to Service Under System of Maintenance

Assuring the ongoing airworthiness of the RPA in day to day operations.

Documented procedures must be in place that detail how the RPAS is declared serviceable for each intended operation.

Control 3.3: Maintenance/Inspection Regime

Ensuring all RPA repair and maintenance are conducted accurately.

The RPAS operator must have a documented System of Inspections and Maintenance in place for the RPAS that follows regulatory requirements, manufacturer's recommendations and sound engineering and maintenance principles.

A system of defect recording and rectification must be established.

RPAS performance must be recorded and trend monitored to act as 'lead indicators' of future maintenance issues.

For battery powered systems, trend monitoring of battery performance must occur as part of this process.

Any maintenance activity must only be undertaken by appropriately trained and competent persons authorized under the Operations Manual.

Control 3.4: Modifications

Ensuring any modifications to the RPA maintain the original airworthiness and safety margins.

Establish a system to manage modifications to the RPA. Such a system will consider the original certification or approval basis for the RPA, the extent of modifications, the impact of those modifications on the original design criteria and any requirement for ground or flight testing prior to operational use.

Control 3.5: Minimum Demonstrated Experience

Ensuring pilots have minimum RPA type experience and qualifications.

Remote Pilots must have a minimum of type experience with the specific RPA model before employing the system in operations (Appendix 2 RPA Pilots Qualification and Experience). A documented Competency Based Training system may be used as an alternative if agreed to by company.

Control 3.6: Alerting

Ensuring timely alerting and location identification to provide awareness of system status.

The RPAS must be equipped with an alerting system that provides awareness of system status. The alerting system should address:

- Communications link status;
- Control status (e.g. normal/alternate/emergency);
- Power state; and
- RPA tracking and position.

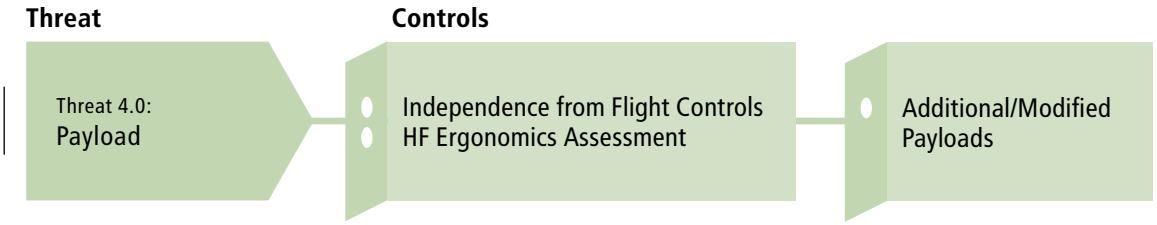
Control 3.7: RPA Suitable for Operating Environment

Ensuring the suitable selection of RPA vehicle.

The RPA must only be operated in environments it was designed for. In offshore locations or for operations above hazardous sites consideration should be given to RPA's that have redundant propulsion and power.

Threat 4.0: Payload

The remotely piloted aircraft payload interferes with the operating aircraft resulting in an accident



Control 4.1: Independence from Flight Controls

Avoiding inadvertent mis-operation of equipment of controls.

Payloads that require operator control from the Ground Control Station (GCS) must be designed such that the payload controls and flight control are independent of each other.

Control 4.2: Human Factors Ergonomics Assessment

Ensuring Human Factors ergonomics assessment is conducted for payload controls.

RPAS and Payload controls must undergo a Human Factors ergonomic assessment to identify and mitigate risks associated with control confusion.

Control 4.3: Additional/Modified Payloads

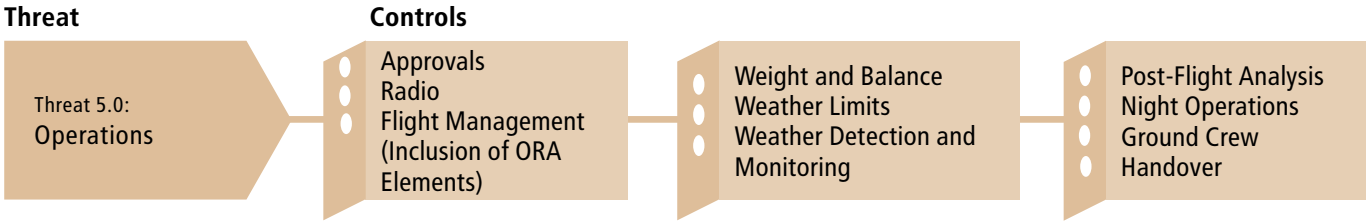
Assuring the maintenance of the airworthiness of the RPA with different payloads.

Establish a system to manage payloads attached to the RPA. The system should consider the original certification or approval basis for the RPA and payload, the impact of the payload on the original RPA design criteria, changes to RPA performance and any requirement for ground or flight testing prior to operational use.

Courtesy Newcrest

Threat 5.0: Operations

The remotely piloted aircraft is operated in such a way that it results in an accident



Control 5.1: Approvals

Deconflicting RPAS operations from community and environment.

The RPAS operator must have a system in place to apply for and receive the applicable approvals for the intended operating site. Interaction with other activities and the impact of RPAS operations must be fully considered (e.g. blasting activities or manned aviation operations).

Control 5.2: Radio

Ensuring radio and communication systems are approved and used appropriately.

The RPAS operator must possess the appropriate radio communications licenses for the RPAS and all payload communication systems, equipment and procedures applicable to the airspace environment intended for use. The RPA must be equipped with the appropriate avionics equipment to meet the airspace operating requirements (e.g. radio, transponder, detect and avoid technology, radio frequency licenses etc).

It is also suggested that the RPAS team has an additional backup Air Band radio to assure contingency if primary should fail. Conflict can be experienced with other frequencies on the mines and operations. Mining/Operations Command and Control frequencies and compatibility to be addressed as well as any additional frequency spectrum approvals.

Control 5.3: Flight Management (Inclusion of ORA Elements)

Ensuring the risks and associated controls and defences are considered for each intended operation of the RPA.

The RPAS operator must have a documented procedure that addresses the conduct of each flight. This document should describe the conduct of the flight and include information such as the operating area, airspace considerations, takeoff and landing sites, waypoints, broadcast requirements, power/fuel reserves, etc. and must consider both planned and unplanned circumstances such as powerplant failure, loss of link/communications/GPS signal, conflict with intruder aircraft or birds, etc. The operator should consider the use of written checklists for the planning and operation of the RPAS task.

Control 5.4: Weight and Balance

Ensuring the RPA remains within the designed performance limits.

The RPAS operator must have a documented procedure to calculate the Weight and Balance of the RPA.

Control 5.5: Weather Limits

Ensuring environmental operating criteria minimum limitations are in place.

The RPAS operator must publish minimum operating criteria for both the RPA and the control console that define limits for the following items:

- Cloud;
- Visibility;
- Wind;
- Turbulence;
- Icing; and
- Temperature Limits.

Control 5.6: Weather Detection and Monitoring

Ensuring weather conditions assessment and verification are conducted for RPA operation.

The RPAS operator must have procedures in place to verify that weather conditions are suitable for the intended (forecasts) and ongoing (observations) operation of the RPA. The impact and assessment of wind conditions at all operating levels is of critical importance and deserves specific consideration. When weather conditions deteriorate to minimum limits the operator must define procedures for immediate recovery of the RPA.

Control 5.7: Post-Flight Analysis

Providing a system of learning and feedback for RPA operation.

RPAS operations must include the requirement for post-flight analysis of both operator and platform performance. Development of a standardized post-flight debriefing template will greatly assist in the conduct of the debrief.

Threat 5.0: (cont.)

Control 5.8: Night Operations

Ensuring safe and approved night operations and identification of all operating hazards.

Night operations must only be undertaken when specific responsible regulatory authority permission or exemptions have been granted and the operator has night operations procedures in their operations manuals. RPAS pilot must be night rated and have the required competence and experience for night operations in accordance with Appendix 2.

Prior to night operations, the RPAS operator must visit the site and complete the ORA in conditions of daylight sufficient to identify all operating hazards.

Control 5.9: Ground Crew

Ensuring ground crew are fully inducted and trained for safe operations.

Any ground crew used in support of RPAS activities must be fully safety inducted, be appropriately trained on the equipment in use and wear clothing appropriate to the task.

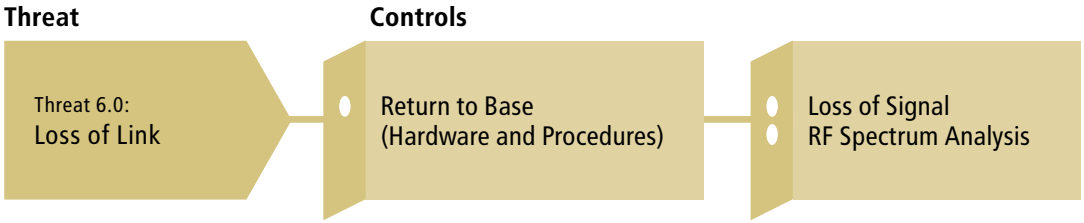
Control 5.10: Handover

Ensuring continuity in multi-pilot operations.

Where control of an RPA is to be handed over to a new pilot or an alternate GCS, the RPAS operator must have procedures and checklists in place to confirm that the disposition of the RPA is understood by both parties and that all GCS settings are appropriate for control changeover.

Threat 6.0: Loss of Link

The RPAS loses its Command, Control, Communication or GPS Link resulting in loss of control of the RPA, causing an accident



Control 6.1: Return to Base (Hardware and Procedures)

Ensuring a planned safe outcome for loss-of-link or emergency RPA situation.

All RPAS must have a redundant control mechanism and supporting procedures that allow for a 'Return to Base' or 'Autoland' procedure when commanded by the operator, or when defined conditions (e.g. loss of link) are encountered. The establishment of flight termination criteria should form part of the preflight risk assessment process and should take into account hazards such as terrain, airspace and Regulatory requirements for this semi-autonomous flight regime.

Control 6.2: Loss of Signal

Ensuring a planned safe outcome for loss-of-link or emergency RPA situation.

All RPAS must have supporting procedures addressing actions in the event of a loss of link between the RPA and the GCS.

Control 6.3: RF Spectrum Analysis

Reducing the risk of C3 interference.

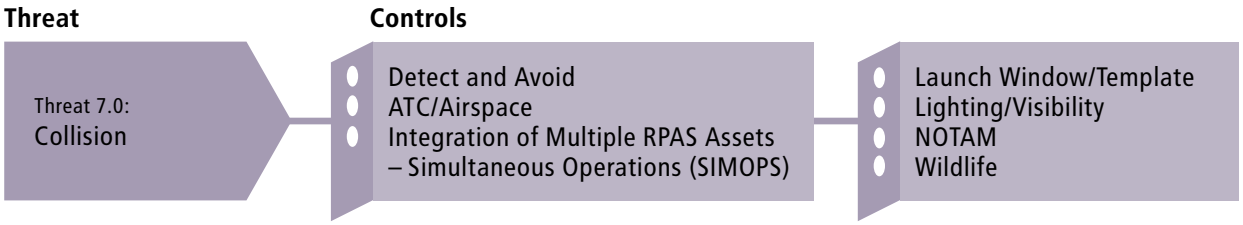
As part of the prefight risk assessment process, the RPAS operator should where practicable conduct an RF spectrum analysis to ensure that Electromagnetic Interference/ Electromagnetic Compatibility (EMI/EMC) is assessed as suitable for the intended operation.

Include in this review any frequencies relating the communication spectrum of the various payloads carried.

Courtesy BHP

Threat 7.0: Collision

The RPA collides with fixed or moving obstacles causing an accident



Control 7.1: Detect and Avoid

Ensuring RPA equipped with detect and avoid systems.

Where available for the RPAS type, detect and avoid systems should be incorporated in the design where a risk assessment validates their employment as a risk mitigating strategy.

For BVLOS activities, the detect and avoid system must meet the prescribed performance levels as determined by the Safety Case.

Control 7.2: ATC/Airspace

Deconflicting the RPAS activity with other aviation activities.

The RPAS operator must have an assessment process that considers the boundaries of the airspace intended for use for both normal and degraded/emergency operations. Absolute clarity must be achieved during pre-mission planning about what other manned and unmanned activity could potentially occur within the same airspace block. Details of the flight should be registered with ATC if operations in shared airspace are to be conducted and conflict with other aviation activities is possible.

Control 7.3: Integration of Multiple RPAS Assets – Simultaneous Operations (SIMOPS)

Ensuring SIMOPS are conducted fully integrated or separated to avoid collision.

Where multiple RPAS assets will be operating simultaneously in the same area, the RPAS operator must ensure that validated SIMOPS procedures are in place to ensure operations are either fully integrated or fully separated.

Control 7.4: Launch Window/Template

Ensuring launch site is hazard and FOD free for takeoff and landing.

The areas used for takeoff and landing must be fully assessed against prescribed criteria to ensure that separation from hazards and obstacles can be adequately achieved. Segregation from personnel not directly associated with the operation of the RPAS must be a prime consideration.

Control 7.5: Lighting/Visibility

Ensuring RPA is visible in the operating area during visual line of sight operations.

RPA should be painted/marked/lit such that it is easily visible during the scope of visual line of sight operations to both the operator and other personnel in the operating area.

Control 7.6: NOTAM

Deconflicting the RPAS activity with other aviation activities.

The RPAS operator must have a documented procedure for the application to release a NOTAM addressing the scope of intended operations.

Control 7.7: Wildlife

Ensuring ORA identifies and mitigates wildlife hazards.

Wildlife hazards, particularly that of predatory birds, must be considered as part of the ORA.

Courtesy Northrop Grumman

Defences 20.0: Aircraft Accident

Mitigating defences in the event of a vehicle accident or loss

Defence 20.1: Engine Failure

Assessment of the risks associated with powerplant failure.

RPAS operators must have procedures available addressing the management of one or more powerplant failures on the RPA. The preflight risk assessment should consider the engine/motor failure risk and include consideration of quarantining the operational area below the intended operation and/or a system with redundant propulsion/power. Quadrotor systems typically do not have redundant propulsion.

Where such controls are not possible to implement, the DROPS calculator should be utilised to consider the residual risk.

Defence 20.2: Emergency Equipment

Ensuring emergency equipment are provided and available.

Emergency equipment such as, but not limited to, fire extinguishers, first-aid kits, portable eye-wash units, overheating battery containers and fire-proof gloves must be provided at the operating site.

These containers, gloves and bags must be readily available during transport of equipment – especially if transported aboard aircraft.

Defence 20.3: Emergency Response Plan (ERP)

Ensuring adequate and appropriate emergency response procedures are in place and up to date.

All RPAS operations must be conducted with an Emergency Response Plan in place that addresses the actions required in the event of an incident/accident. The ERP must specifically address management of the risks associated with a loss of Command/Control/Communications and the alerting requirements to ATC and manned aircraft that might be in the area. The ERP should also consider hazardous materials used on the RPA and actions to be taken to control the risk of third-party damage in the event of an accident or loss of platform. The ERP should also address required communication channels are in place for each specific activity - all hazards mentioned in the ERP must be addressed in the primary hazard and risk register.

Defence 20.4: Insurance

Ensuring business continuity for the RPAS operator.

The RPAS operator, whether internal to the organization or externally contracted, must have third party public liability insurance coverage specifically for RPAS activities and for the period of the contracted activity. Third party public liability insurance must be established in accordance with the output of the detailed risk assessment of the activity prior to the commencement of operations and should be not less than US$5M.

When considered necessary, company should be named as additional insured under the contract and evidence of the cover made upon request. Such insurance must not be cancelled or changed materially during the course of the contract without at least 30 days written notice to the company.

Defence 20.5: Incorporation of Research and Development Outcomes

Ensuring continuous improvement in safety performance.

Where technical standards and innovations improve RPAS, the contracting company should consider upgrading contracted RPAS to a later developmental standard for improved operational and safety performance. Examples include the inclusion of collision risk mitigation technologies, improved crashworthiness and better command, control and communication systems.

Defence 20.6: Public Relations

Reducing reputational damage risks associated with RPAS operations.

The RPAS operator and contracting company should develop and implement a Public Relations strategy where public interest in operations is likely to be generated.

Defence 20.7: Investigation Procedures

Ensuring accurate causal factors and accident mitigations are identified and learnt.

Each RPAS operator must have a defined investigation procedure that focuses on identification of root causes and the prevention of recurrence. Investigation procedures should be based on ICAO Annex 13 principles. Procedures should be developed for preservation and security of data recorded during the subject flight to assist with the investigation process.

Appendices

Courtesy Newcrest

Appendix 1:

Generic RPAS Governance Model

RPA	Operating Conditions	Governance Model
Very Small	1. Standard Operating Conditions	Approvals maintained at local site/asset/business unit. All Remote Pilots have RPL or permit that meets local regulatory requirements. Using all applicable controls contained within the FSF BARS RPAS Standard and contingent on: (1) Approved company management procedure in place; and (2) Completed Operational Risk Assessment for the task/activity.
Small		
Very Small	1. Non-standard Operating Conditions 2. BVLOS/Night Operations	Company approved operator, holds either external ReOC or internal (company) ReOC. All Remote Pilots have RPL or permit that meets local regulatory requirements. Audited against a defined protocol to facilitate company approval process. Using all applicable controls contained within the FSF BARS RPAS Standard and contingent on: (1) Approved company management procedure in place; and (2) Completed Operational Risk Assessment for the task/activity.
Small		
Medium	1. Standard Operating Conditions 2. Non-standard Operating Conditions 3. BVLOS/Night Operations	
Large		

Appendix 2:

Remote Pilot Qualifications, Experience and Recency

RPA	Operating Conditions	Licence	Total Hours	Missions on Type	Recency	Simulator
Very Small Small	1. Standard Operating Conditions	RPL	5	5	Three takeoff and landing (launch/ capture) cycles in previous 90 days	As required
Very Small Small	1. Non-standard Operating Conditions 2. BVLOS/Night Operations	RPL	20	10		
Medium Large	1. Standard Operating Conditions 2. Non-standard Operating Conditions 3. BVLOS/Night Operations	RPL and Instrument Rating (theory)	100	20		Annual

Key Definitions

AGL Above Ground Level
ATC Air Traffic Control
BVLOS Beyond Visual Line of Sight
CFIT Controlled Flight into Terrain
Company Individual entity or organization using RPAS activities
EMC Electro Magnetic Compatibility
EMI Electro Magnetic Interference
Flight Cycle One takeoff, transition from hover or climb to altitude and one landing
FOD Foreign Object Damage
GCS Ground Control Station
GPS Global Positioning Satellite
HLO Helideck Landing Officer
HLS Helicopter Landing Site
ICAO International Civil Aviation Organization
IFR Instrument Flight Rules
IMC Instrument Meteorological Conditions
Intrinsic Safe Operations - is a protection technique for safe operation of electrical equipment in hazardous areas limiting the energy, electrical and thermal, available for ignition. Areas with dangerous concentrations of flammable gases or dust are found in applications such as petrochemical refineries and mines.
IP Ingress Protection
IR Infra Red
LiDAR Light Detection and Ranging
LiPo Lithium Polymer
NAA National Aviation Authority
NM Nautical Mile
NOTAM Notice to Airman
Operator Operating entity providing RPAS services. Can be internal or external to company
OHS Occupational Health and Safety
ORA Operational Risk Assessment
PIC Pilot-in-Command
PPE Personal Protective Equipment
ReOC RPA Operator's Certificate
RF Radio Frequency
RPL Remote Pilot Licence
RP Remote Pilot
RPAS Remotely Piloted Aircraft System
RPA Remotely Piloted Aircraft
RPS Remote Pilot Station
RTB Return to Base
SIMOPS Simultaneous Operations
TCAS Traffic Collision Avoidance System
UAS Unmanned Aerial System
VFR Visual Flight Rules
VLOS Visual Line of Sight
VMC Visual Meteorological Conditions
C3 Command, Communication and Control

Weight Categories of RPA

Very small An RPA with a gross weight of more than 100g but less than 2kg.
Small An RPA with a gross weight of at least 2kg but less than 25kg.
Medium An RPA with a gross weight of at least 25kg but not more than 150kg.
Large An RPA with a gross weight of 150kg or more.

Appendix 3:

RPAS Operational Risk Assessment (ORA)

The Operational Risk Assessment must be a documented process that records all hazards and threats associated with RPAS operations. The outcome of the ORA will be to identify clear mitigating controls used to manage the risk associated with this activity. These mitigating controls should be summarized and briefed to all participants prior to the commencement of operations.

Table 1: Example of Operational Risk Assessment – any answer 'No' requires identification of mitigating Controls or Defences followed by discussion and agreement with management or contracting company's representative prior to flight.

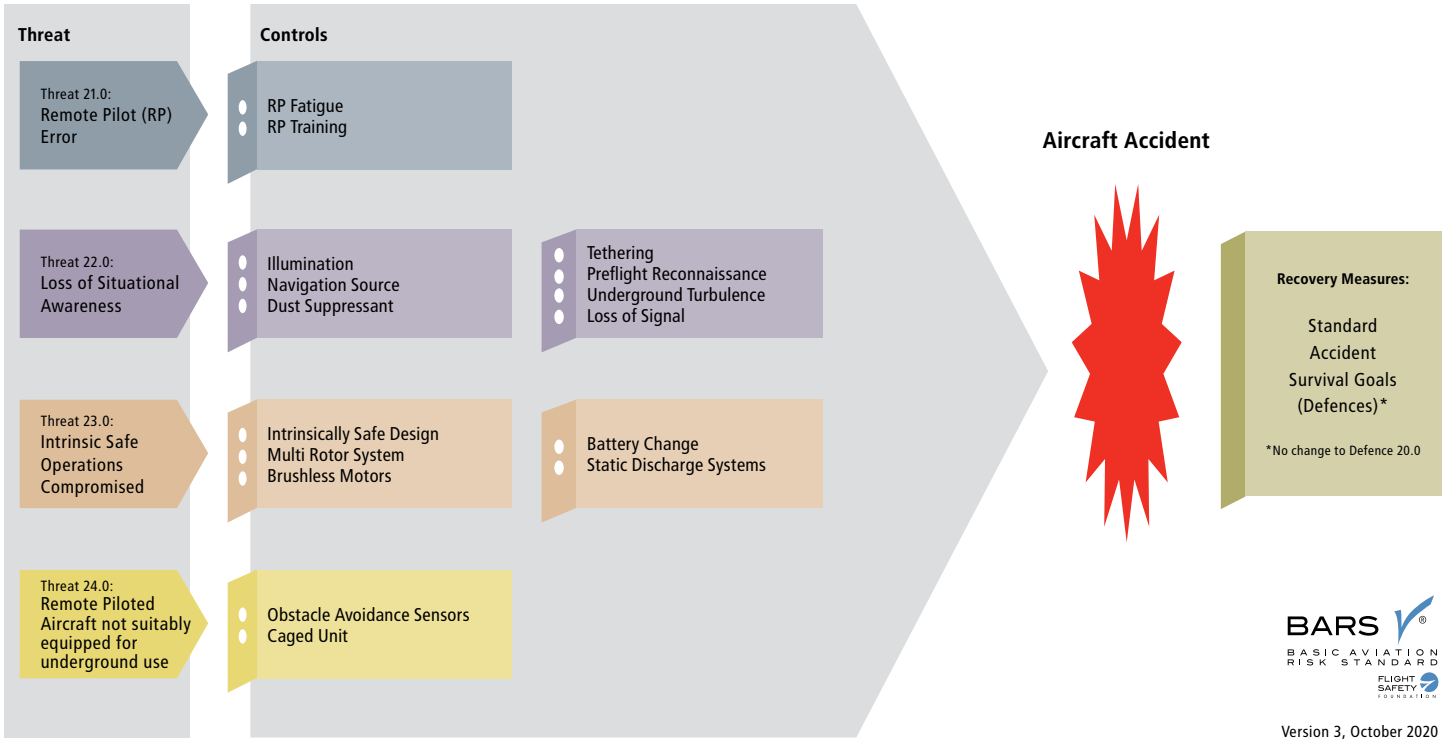
Control	Query			Additional Mitigations
Planning	Is the operation being conducted in accordance with the Standard Operating Conditions? • Operation of one RPA per Remote Pilot at any one time; • Maintaining Visual Line of Sight (VLOS) during day operations and below 400 feet Above Ground Level (AGL); • Not to be operated closer than 30 meters to personnel who are not associated with the flight; • Not to be flown over populous areas and/or personnel in the area of operation; and • Not to be flown within 3 nautical miles (nm) of any aerodrome, and to remain outside all active prohibited and restricted areas.	Y	N	If no, the operations should not take place until the Standard Operating Conditions are satisfied OR the activity is undertaken using an operator with a valid ReOC.
Remote Pilot	Is the Remote Pilot properly qualified and experienced in accordance with Appendix 2?	Y	N	If no, either complete additional training or currency flying outside the tasking environment to meet the required standards.
	Is the Remote Pilot or any member of the ground affected by fatigue?	Y	N	If yes, postpone operation until fatigue status is suitable for the intended operation.
	Is the Remote Pilot or any member of the ground affected by D&A?	Y	N	If yes, postpone operation until D&A status is suitable for the intended operation.
RPA	Has the RPA been inspected and considered airworthy for the intended operation?	Y	N	Complete inspection and verify airworthiness.
	Is any outstanding maintenance due?	Y	N	If yes, complete required maintenance prior to flight.
	Are all elements of the RPA and RPAS Control System functioning correctly?	Y	N	If no, rectify defects or verify that the defective system is not required for the intended flight.
	Has a performance assessment been completed for the RPA to verify that it is suitable for the intended task in the forecast operating environment?	Y	N	If no, complete assessment. If the assessment results confirm that the operating environment is not suitable, postpone the flight or modify the intended task so that it meets performance criteria.
	Is a Certificate of Airworthiness required?	Y	N	If the C of A has not been validated or not issued, cancel the intended flight.
	Has a Release to Service certification been completed?	Y	N	If no, complete a Release to Service certification prior to flight.
Power Source	Are all batteries fully charged or fuel load sufficient for planned sortie?	Y	N	If no, source replacement batteries or additional fuel.
	Is the power source indicator functioning correctly and is it indicating the expected figure?	Y	N	If no, do not commence flight until the defect is rectified.
	Have all batteries or fuel been stored and transported appropriately?	Y	N	If no, complete testing of fuel source to confirm it is suitable for use.
	Is the method of fuel and battery management, testing, sampling, connection/delivery understood by the operator and/or ground crew?	Y	N	If no, postpone the operation and completed training of staff to confirm that the appropriate power source management procedures are in place.

Control	Query			Additional Mitigations
Weather	Has a forecast of the daily weather conditions been received?	Y	N	If no, source a weather forecast to verify that conditions are suitable.
	Are any localized weather phenomenon likely to impact operations?	Y	N	If yes, postpone flight until conditions are suitable.
	Have the following weather limits been established? • Cloud; • Turbulence; • Visibility; • Icing; and • Wind; • Temperature Limits.	Y	N	If no, establish the required limits and comply with them in operations.
	Have the weather limits been briefed and understood by all?	Y	N	If no, provide training to confirm that the weather limits are understood.
Operations	Does the operation require regulatory approval?	Y	N	If yes, confirm that regulatory approval has been provided.
	Has an airspace assessment been completed?	Y	N	If no, complete an airspace assessment to confirm that the intended operation can be undertaken without penetrating unapproved airspace.
	Does the operation require NOTAMs to be issued?	Y	N	If yes, confirm that the applicable NOTAMs have been released.
	Has a radio check been completed to verify radio serviceability?	Y	N	If no, conduct radio check. If radio check confirms radio is not serviceable, have defect rectified before flight.
	Have the necessary radio broadcasts been completed?	Y	N	If no, conduct the required radio broadcasts.
	Is the RF spectrum analysis complete?	Y	N	If no, complete an RF spectrum analysis to confirm that the operation can be effectively conducted with no impact to operations.
	Are the launch and recovery areas suitable?	Y	N	If no, relocate to a more suitable area.
	Are the lost link procedures understood?	Y	N	If no, conduct training to confirm that all staff involved with the operation understand the procedures and actions required should a lost link event occur.
	Verify that the correct RTB position has been established?	Y	N	If the incorrect RTB position is programmed, amend the position to the correct location.
	Is the appropriate emergency equipment on hand?	Y	N	If no, postpone the flight until the required equipment is on hand.
	Are all team members briefed and ready for the intended operation?	Y	N	If no, postpone the operation until the necessary briefings have been completed and every team member is ready.
	Is the launch and recovery site clearly demarcated?	Y	N	If no, postpone operations until launch and recovery site is clearly identified to safeguard unauthorized entry of persons.
	Is the launch and recovery site protected from an unauthorized/accidental entry?	Y	N	If no, postpone operations until launch and recovery site is effectively protected from entry of personnel.
	Has effective dust suppression mitigations been implemented for under ground or for surface operations?	Y	N	If no, postpone operations until such time as an effective dust suppression practice has been applied to the launch and recovery site that will be effective for the duration of the RPAS operation.

Appendix 4:

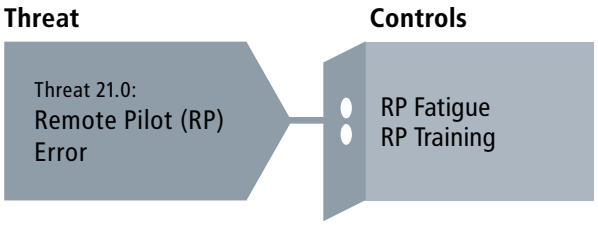
Underground and/or Confined Space RPAS Operations

Figure 2: BARS Bow Tie Risk Model – Schematic of RPAS Management Controls and Recovery Measures for Underground or Confined Space Operations



Threat 21.0: Remote Pilot (RP) Error

The Remote Pilot makes an error of judgement and loses control of the RPA



Control 21.1: RP Fatigue

Ensuring remote pilot fatigue is minimized by appropriate management and pre-start risk assessment.

A fatigue management plan must be in place prior to the start of the activity and which takes into account the additional demands that operating an RPA underground places on the Remote Pilot.

Control 21.2: RP Training

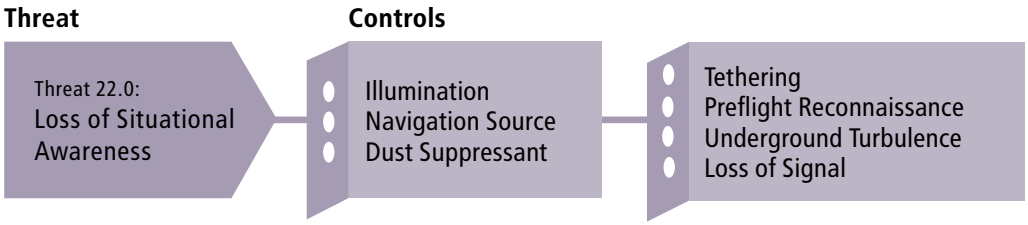
Ensuring remote pilots are competent to operate RPA without GPS signal in an underground environment.

The Remote Pilot must undergo specific training associated with absence of GPS signal in an underground environment (such as operating in manual-mode) before commencing first operation.

Courtesy BHP

Threat 22.0: Loss of Situational Awareness

The Operator loses situational awareness and the RPA loses control and crashes



Control 22.1: Illumination

Ensuring adequate illumination in the absence of natural light.

Consideration in applying additional illumination on the RPA and/or in the surrounding environment must form part of the pre-start Operational Risk Assessment.

Control 22.2: Navigation Source

Ensuring accurate RPA navigation in the absence of external navigation signals.

Consideration in applying a Light Detection and Ranging (LiDAR) mapping capability as a navigation source on-board the RPA must form part of the pre-start Operational Risk Assessment.

Control 22.3: Dust Suppressant

Ensuring the maintenance of visual reference in contaminated environmental conditions.

Use of water or any alternative (mobile platform) as a suppressant in areas of high dust (such as launch and recovery sites) must be considered as part of the pre-start Operational Risk Assessment to minimize loss of visual reference.

Control 22.4: Tethering

Provision of a RPA retrieval mechanism in hazardous environments.

Use of an approved tether mechanism attached to the RPA when being used underground should be considered to assist recovery of the unit anytime a return-to-launch site is unsuccessful.

Control 22.5: Preflight Reconnaissance

Ensuring the maintenance of situational awareness in a unique operating environment.

Conduct of a preflight reconnaissance of the layout to be surveyed/inspected will assist in the overall situational awareness of the RP and should be conducted as part of the Operational Risk Assessment.

Control 22.6: Underground Turbulence

Ensuring awareness of environmental hazards in a unique operating environment.

During the Operational Risk Assessment the identification of any potential underground turbulence (such as ventilation systems) must be noted and documented for RP awareness.

Control 22.7: Loss of Signal

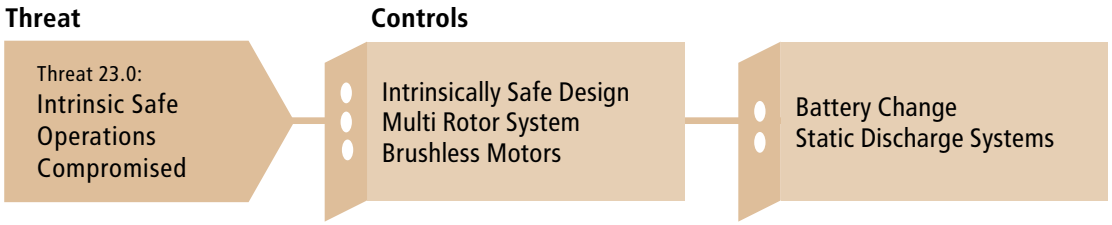
Ensuring the maintenance of C3 in a unique operating environment.

The addition of repeaters or any signal boost capability must be considered prior to start if loss or reduction of signal between the RP and the RPA is possible.

Courtesy BHP

Threat 23.0: Intrinsic Safe Operations Compromised

The intrinsic safe operation of the RPAS is compromised and a materially unwanted event results



Control 23.1: Intrinsically Safe Design

Elimination of the RPA as a potential ignition source in a potential flammable environment.

Where required by law or a potential or suspected flammable atmosphere may exist any RPA used in an underground environment must adopt an intrinsically safe design approach to ensure an ignition source from a spark or hot surface will not be a threat.

In the absence of an intrinsically safe design, all risks associated with operating an RPA which is not certified intrinsically safe must be considered in the ORA and mitigated via alternative means.

Control 23.2: Multi Rotor System

Ensuring RPA maneuverability in confined space by utilizing a multi-rotor system.

A multi-rotor system RPA should be considered when operating in confined spaces and/or an underground environment to provide the required redundancy and maneuverability.

Control 23.3: Brushless Motors

Elimination of the RPA as a potential ignition source in a potential flammable environment.

Only brushless motors are to be used in an underground environment to avoid any risk of ignition source from the powerplant.

Control 23.4: Battery Change

Elimination of the RPAS as a potential ignition source in a potential flammable environment.

All battery changes must be performed at the surface (or in pre-approved and sealed 'safe' rooms underground) to avoid any threat of inadvertent ignition source compromising continued intrinsically safe operations.

Control 23.5: Static Discharge Systems

Elimination of the RPA as a potential ignition source in a potential flammable environment.

RPAs that have any form of static discharge system must not be used in an underground environment.

Threat 24.0: Remote Piloted Aircraft not suitably Equipped for Underground use

The RPA is not suitably equipped and an accident results

Threat	Controls
Threat 24.0: Remote Piloted Aircraft not suitably Equipped for Underground use	Obstacle Avoidance Sensors Caged Unit

Control 24.1: Obstacle Avoidance Sensors

Provision of suitable equipment to avoid terrain or obstacle contact.

Obstacle avoidance sensors in all six-axis is highly desirable to avoid inadvertently flying the RPA into terrain. A range of onboard obstacle avoidance systems include Light Detection and Ranging (LiDAR) mapping, stereo vision, monocular vision, ultrasonic and infrared sensors.

Control 24.2: Caged Unit

Provision of suitable equipment to mitigate terrain or obstacle contact.

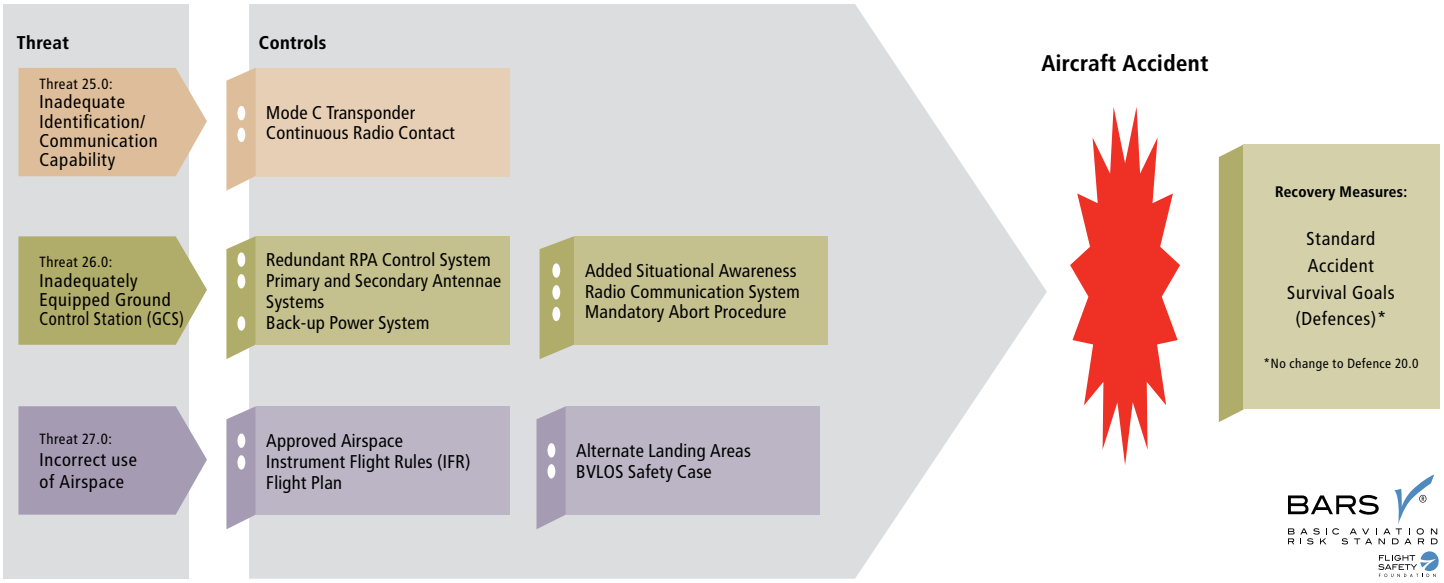
Consideration in the provision of an approved and serviceable cage (or external frame system) surrounding the RPA should occur during the Operational Risk Assessment to aid in the prevention of injury and/or accident in the event if inadvertent contact with obstacles.

Courtesy Altitude Imaging

Appendix 5:

Beyond Visual Line of Sight (BVLOS)/IFR/Controlled Airspace RPAS Operations

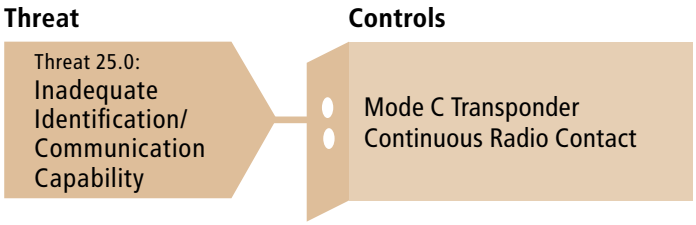
Figure 3: BARS Bow Tie Risk Model – Schematic of RPAS Management Controls and Recovery Measures during BVLOS, IFR or Controlled Airspace Operations



Version 3, October 2020

Threat 25.0: Inadequate Identification/Communication Capability

RPA identification and/or communication systems are inadequate for the task resulting in a materially unwanted event



Control 25.1: Mode C Transponder

Ensuring awareness and separation of other aviation assets during RPAS operations.

A serviceable Mode C transponder (ADS-B Mode S preferred) must be provided on the RPA.

Control 25.2: Continuous Radio Contact

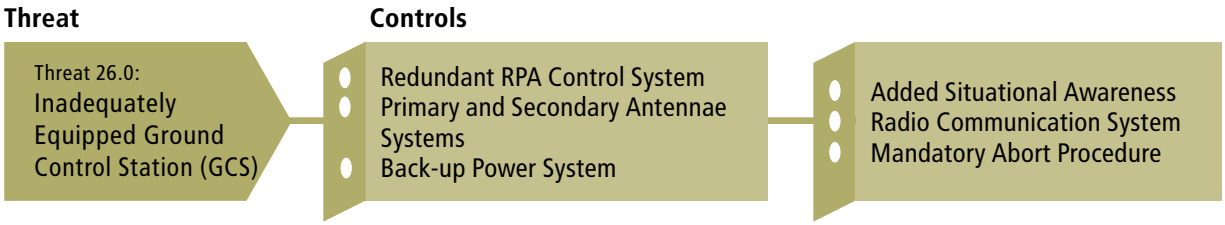
Ensuring awareness and separation of other aviation assets during RPAS operations.

During operations, the Remote Pilot must maintain continuous radio contact with all other airspace users during the entire flight.

Courtesy Northrop Grumman

Threat 26.0: Inadequately Equipped Ground Control Station (GCS)

The provision of an inadequately equipped GCS results in loss of RPA and a materially unwanted event



Control 26.1: Redundant RPA Control System

Ensuring back-up system in place to control the RPA in case of unwanted events.

The GCS must have a back-up system to control the RPA to provide the required level of redundancy.

Control 26.2: Primary and Secondary Antennae Systems

Ensuring GCS provide appropriate level of redundancy by utilizing primary and secondary antennae system.

The GCS must have both a primary and secondary antennae system to provide the required level of redundancy.

Control 26.3: Back-up Power System

Ensuring recovery of RPA utilizing back-up power supply in case of primary power source failure.

An Uninterrupted Power Supply (UPS) battery back-up (or equivalent alternative) must be provided in the event of primary power source failure. The UPS must power all mission-critical systems for the duration required to recover the RPA in a worse-case scenario (ie the furthest point from recovery).

Control 26.4: Added Situational Awareness

Provision of redundant situational awareness systems during BVLOS operations.

An additional means of providing situational awareness over and above radio communications, such as a web-based data capability that shows the RPA and any surrounding traffic, must be provided to the RP and supporting personnel.

Control 26.5: Radio Communication System

Ensuring availability of constant communication system.

A primary and backup radio communication system must both be serviceable to provide the required redundancy level.

Control 26.6: Mandatory Abort Procedure

Ensuring mandatory abort is performed where degradation of the GCS or RPA is identified.

A mandatory abort procedure must be in place for anytime a degradation of the GCS or RPA is identified (as outlined in all aforementioned controls).

Threat 27.0: Incorrect use of Airspace

The incorrect use of airspace results in traffic conflict and mid-air accident with manned aircraft

Control 27.1: Approved Airspace

Ensuring operational airspace are safe and approved for the operation.

When possible, the airspace for use should be designated as a Danger or Restricted area or at the very least activated by NOTAM.

Control 27.2: Instrument Flight Rules (IFR) Flight Plan

Ensuring separation of known traffic.

An IFR flight plan (or equivalent level of flight notification) must be submitted for all flights.

Control 27.3: Alternate Landing Areas

Ensuring alternate landing areas are identified and approved.

Alternate landing areas must be identified throughout the airspace coverage for the intended mission and appropriate approvals for use obtained.

Control 27.4: BVLOS Safety Case

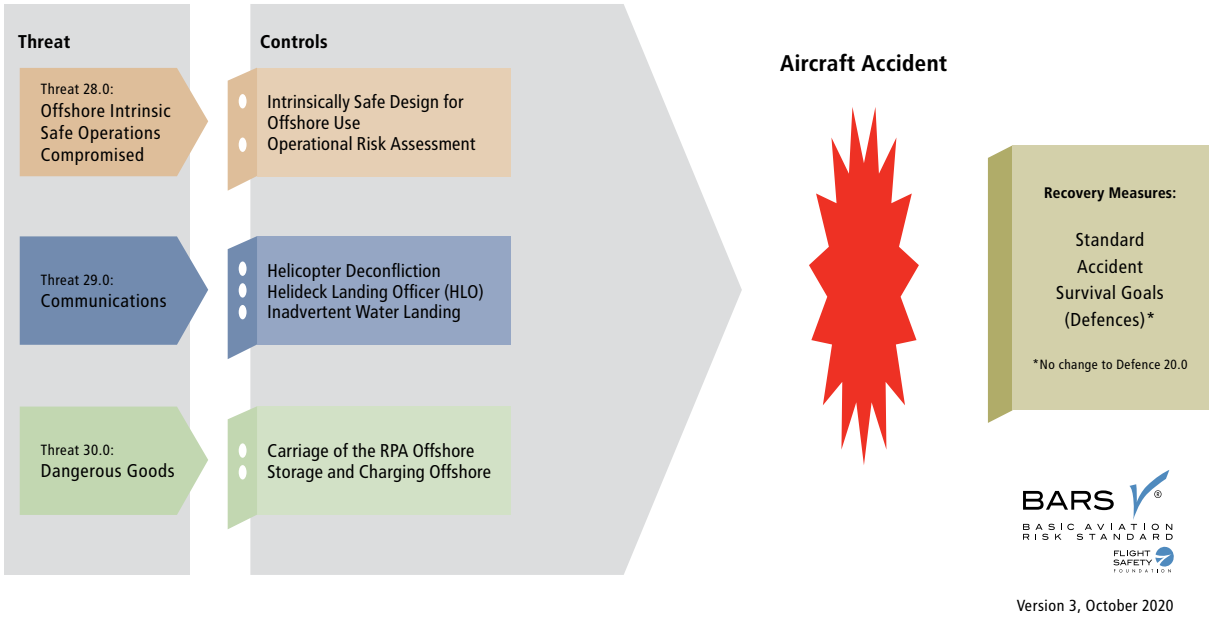
Ensuring BVLOS operations have all relevant risks identified and addressed.

For any BVLOS activity, a Safety Case to the satisfaction of the NAA, as well as the client company, will need to be developed and approved prior to any operation. If operating in a region where the NAA does not have BVLOS regulatory requirements the current global regulatory guideline is the JARUS SORA process.

Important to also note that, depending on the region, other regulatory approvals such as radio spectrum authorization as well as military/security approvals may be required.

Offshore Installation/Maritime RPAS Operations

Figure 4: BARS Bow Tie Risk Model – Schematic of RPAS Management Controls and Recovery Measures during Operations in a Maritime or Offshore Installation Environment



Version 3, October 2020

Threat 28.0: Offshore Intrinsic Safe Operations Compromised

The intrinsic safe operation of the RPAS in the offshore environment is compromised and a materially unwanted event results

Control 28.1: Intrinsically Safe Design for Offshore Use

Elimination of the RPA as a potential ignition source in a potential flammable environment.

Where required by law or a potential or suspected flammable atmosphere may exist any RPA used in an offshore environment must adopt an intrinsically safe design approach to ensure an ignition source from a spark or hot surface will not be a threat.

In the absence of an intrinsically safe design, all risks associated with operating an RPA which is not certified intrinsically safe must be considered in the ORA and mitigated via alternative means.

Control 28.2: Operational Risk Assessment

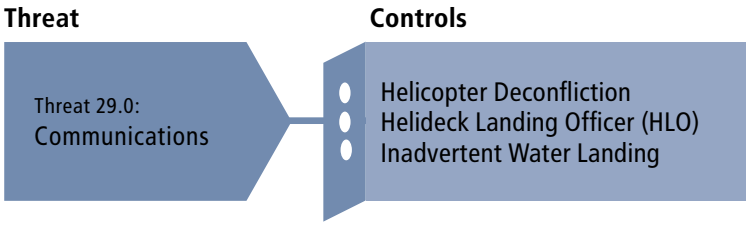
Ensuring ORA identifies and addresses operational hazards and risks.

The location of flare stacks, exhaust vents, areas of known turbulence from the superstructure and projected crane operations must be identified and noted during the Operational Risk Assessment. The derived flight plan route for operations must take this analysis into consideration.

Courtesy "Little Ripper Life Saving"

Threat 29.0: Communications

Effective communications are not maintained and the RPA conflicts with a helicopter, vessel or the installation



Control 29.1: Helicopter Deconfliction

Ensuring deconfliction between RPAS and known helicopter operations.

The daily schedule of all helicopter movements to the offshore installation/vessel must be known and discussed during the Operational Risk Assessment to ensure time based deconfliction between the RPA and helicopter can be maintained.

Control 29.2: Helideck Landing Officer (HLO)

Ensuring deconfliction between RPAS and known helicopter operations.

The HLO (or other suitably nominated representative) must be assigned as the Single Point of Accountability responsible for escorting the RP during all operations. Furthermore, the Single Point of Accountability must maintain constant radio watch with the installation and any aviation traffic.

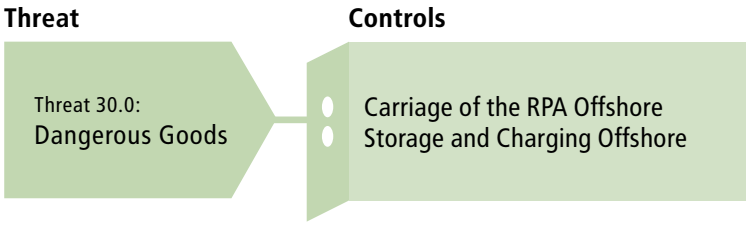
Control 29.3: Inadvertent Water Landing

Provision of RPA location and recovery measures for off vessel landing.

The nominated Single Point of Accountability retains responsibility for noting the RPAs location in the event of an unintended water landing. In order to assure data integrity and minimize damage to the RPA in the event of an inadvertent water landing, consideration must be given to waterproofing data capturing units, sensors, motors, batteries and processors. Additional recovery measures that can be considered must include approved RPA modifications using flotation devices and self-deployed water dye-pack to mark the impact area. Where the RPA and proposed activity can be done using tethering techniques, this method of operation must also be used to avoid loss of unit. Include relevant IP rating for example IP 77.

Threat 30.0: Dangerous Goods

The RPA and its power source is not transported or stored in accordance with requirements and catches fire resulting in a material unwanted event



Control 30.1: Carriage of the RPA Offshore

Ensuring the safe transport of dangerous goods.

The aircraft operator must be consulted regarding the carriage of the RPA and associated batteries to ensure compliance with the IATA Carriage of Dangerous Goods Manual is maintained.

Control 30.2: Storage and Charging Offshore

Ensuring appropriate storage and charging area is available and batteries are identified.

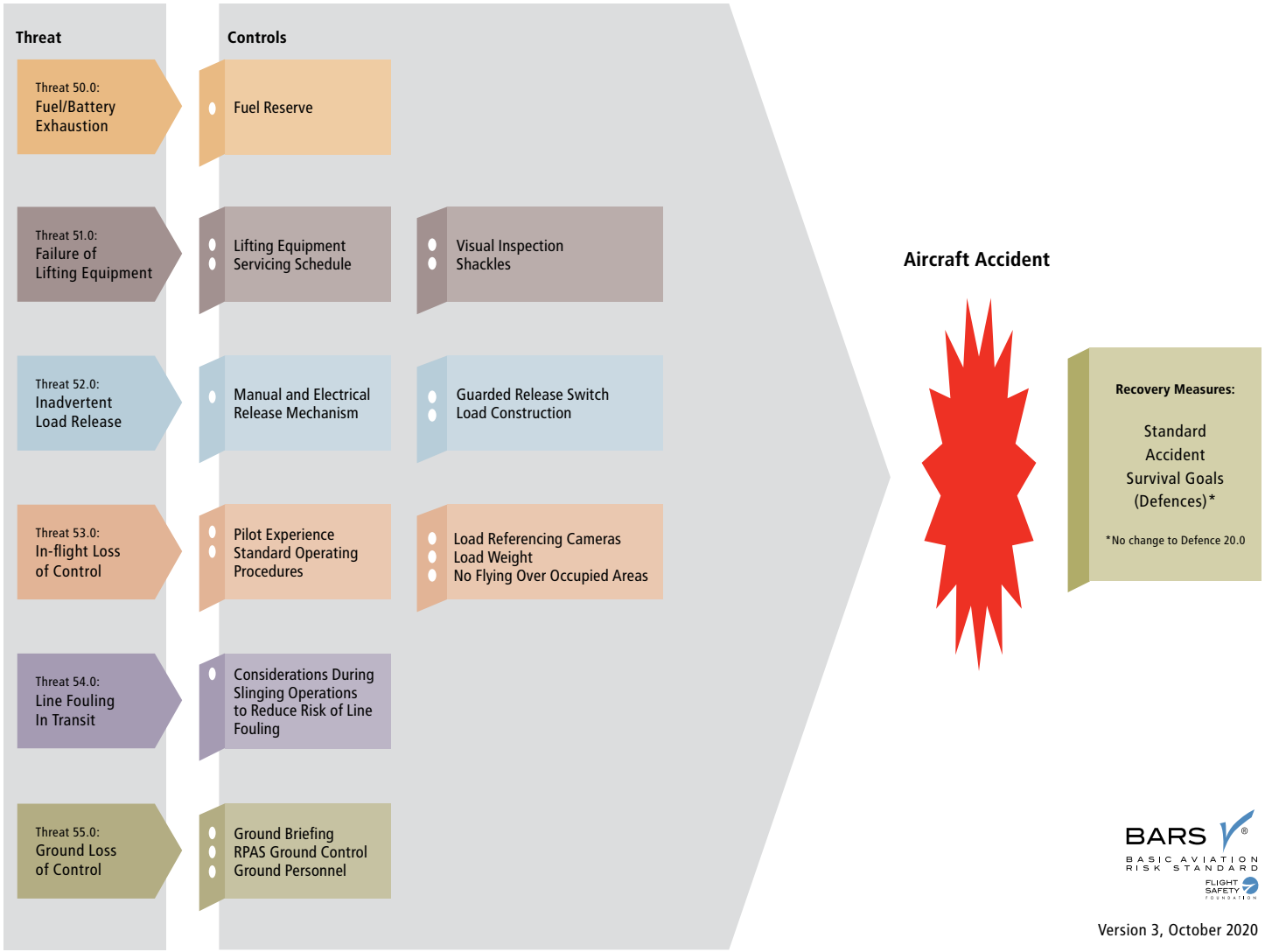
The offshore installation/vessel must be consulted prior to embarkation to ensure the RPA and associated batteries are appropriately tested and tagged and a suitable environment established for storage and charging on the offshore installation/vessel prior to arrival.

Courtesy Freeport

Appendix 7:

RPAS External Load Operations

Figure 5: BARS Bow Tie Risk Model – Schematic of RPAS Controls and Recovery Measures for External Load Operations.

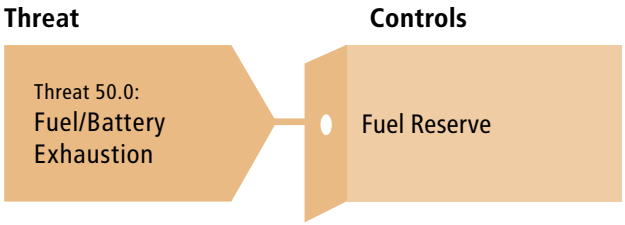


BARS BASIC AVIATION RISK STANDARD FLIGHT SAFETY FOUNDATION

Version 3, October 2020

Threat 50.0: Fuel/Battery Exhaustion

The RPAS operates on minimum fuel load to maximize lifting capability, runs out of fuel/battery life and suffers an engine failure resulting in an accident



Control 50.1: Fuel Reserve

Ensuring sufficient fuel is carried/battery life, including required reserves.

Maintain a minimum fuel reserve 10 minutes/battery life of 30% at all times.

Courtesy: BHP

Threat 51.0: Failure of Lifting Equipment

The lifting equipment fails and drops the load resulting in an accident on the ground

Control 51.1: Lifting Equipment

Ensuring certification of lifting equipment and compliance with the equipment manufacturer's servicing requirements.

The RPAS operator must ensure the serviceability and certified safe working load of lifting equipment is adequate for the task and appropriate to the material used for the line.

Control 51.2: Servicing Schedule

Ensuring early detection of impending failure of load lifting equipment.

Lifting equipment must conform to a servicing schedule that provides all necessary documentation associated with inspections, certification and serviceability. Copies of this servicing schedule must be made available to the RPAS operator's representatives in the field.

Control 51.3: Visual Inspections

Ensuring servicing routines are supplemented with visual inspections prior to each use.

All lifting equipment (cables, lines, straps, baskets, swivels, clevises, etc.) must be inspected by qualified personnel daily prior to the flight. Any signs of wear, fraying, corrosion, kinks or deterioration must result in the equipment being discontinued from use.

Control 51.4: Shackles

Ensuring that shackles are compliant and compatible with other load lifting equipment.

The shackles used to connect the cable to the RPAS must conform to specific Flight Manual supplements (where available) or as described in the operator's operations manual, regarding the diameter of the shackle rings and their use with respective hook types on the RPAS.

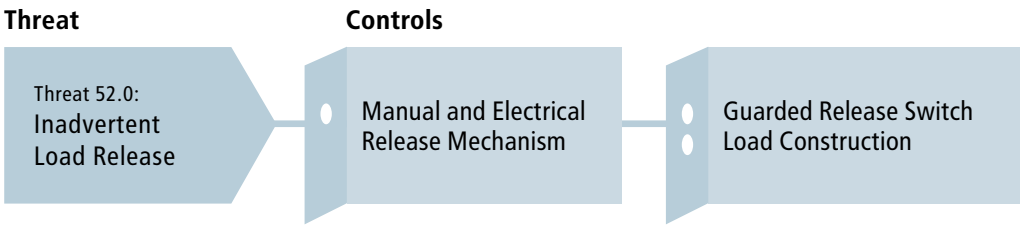
If information is not readily available a risk assessment must be conducted prior to operations being conducted.

From attained results an engineering assessment and solution is to be formulated and implemented.

Note must be taken that all modifications to the craft or systems must be done with approval from the OEM and/or NAA.

Threat 52.0: Inadvertent Load Release

The load is inadvertently released in-flight, falls to the ground and causes an accident



Control 52.1: Manual and Electrical Release Mechanism

Ensuring that RPAS have appropriate mechanisms for release of loads in normal and emergency situations.

The RPAS must have a serviceable remote release mechanism and an external manual release at the hook.

Control 52.2: Guarded Release Switch

Removing the potential of inadvertent load release.

When available for the RPAS controller, all electronic release switches must be guarded or incorporate a safety device (dual switching or similar) to prevent inadvertent activation.

Control 52.3: Load Construction

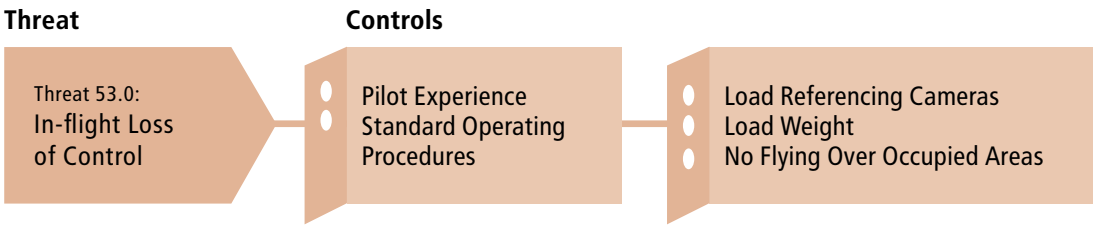
Ensuring that all loads are rigged by appropriately trained and qualified personnel.

The RPAS operator must ensure that all loads are rigged by appropriately trained personnel.

Courtesy: Rio Tinto

Threat 53.0: In-flight Loss of Control

Poor manipulative control in-flight results in a loss of control and an aircraft accident



Control 53.1: Pilot Experience

Ensuring flight crew are adequately trained and have sufficient experience to conduct RPAS external load operations.

Flight crew must be adequately trained and have sufficient experience to conduct RPAS external load operations, commensurate with the risk involved for the specific lifting operation.

Pilots engaged in external load activities must comply with the following requirements:

- Use only licenced RPAS operators who have been approved for use by company established process and where necessary, a Competent Aviation Specialist; and
- If available, the successful completion of an operator's external load training program, the process to be based on the complexity of the task being performed.

Control 53.2: Standard Operating Procedures

Ensuring safe, efficient and standardized external load lifting operations.

The RPAS operator must have Standard Operating Procedures outlining all requirements of personnel engaged in the external load activity. The procedures must be relevant to the local environment and terrain being operated in.

Control 53.3: Load Referencing Cameras

Ensuring enhanced situational awareness of the external load at all times.

Where available for the RPAS type, a camera shall be fitted which allows the pilot a view below the aircraft of the hook and load being carried. Preferably this shall be a separate camera operated independently of the camera used for flight.

Control 53.4: Load Weight

Ensuring accurate load weights are known and within RPAS limits.

All loads must have accurate weights provided to the pilot before each lift. Note must be taken during the planning of sampling operations to assure the additional weight of the sample is accounted for and will not exceed the maximum of the specific platform.

Control 53.5: No Flying Over Occupied Areas

Removing unnecessary exposure to risk for personnel by overflight.

No flight overhead of personnel and occupied vehicles and structures.

Threat 54.0: Line Fouling In Transit

The load becomes detached from the line or the line is flown empty which, when above a certain speed, causes it to stream up and into the rotor systems resulting in an accident

Threat

Threat 54.0:
Line Fouling
in Transit

Controls

Considerations During Slinging Operations to Reduce Risk of Line Fouling

Control 54.1: Considerations During Slinging Operations to Reduce Risk of Line Fouling

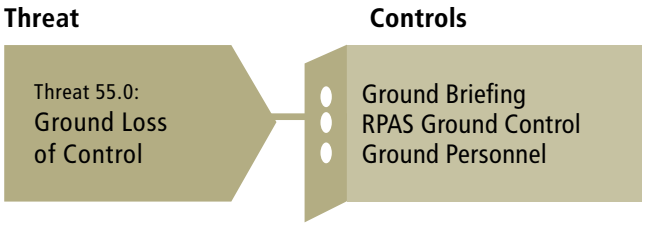
Ensuring RPAS cannot become entangled by fouled lines.

- Transit with a line and no load attached is not permitted;
- The line must be suitably weighted if it is to be flown without a load attached;
- Implement prefight checks which are designed to ensure flight crew involved in repetitive loads are aware of when the line is attached;
- All safe transit speeds, the maximum angle of bank, the maximum allowable rate of descent and general handling associated with stable load operations must be briefed and understood by all flight crew prior to the commencement of operations;
- All applicable never exceed speeds must be briefed and understood by all flight crew prior to the commencement of operations; and
- Where these speeds are not published by an OEM a flight trial program to establish never exceed speeds must be implemented and the results incorporated into the SOP's.

Courtesy: Rio Tinto

Threat 55.0: Ground Loss of Control

A departure from normal operations on the ground results in loss of control of the load and RPAS resulting in an RPAS accident



Control 55.1: Ground Briefing

Ensuring all personnel involved in the external load lifting operations are comprehensively briefed.

The pilot must ensure all personnel involved in the external load activity are briefed prior to the commencement of operations. This brief must include all emergency scenarios that could involve the ground crew.

Control 55.2: RPAS Ground Control

Ensuring safety of all personnel in the vicinity of RPAS conducting external load lifting operations.

Where practical the RPAS must be shut down prior to connection or disconnection of external loads. Where shutdown is not possible a pilot must remain at the controls whilst on the ground at all times. The pilot must remain focussed on control of the aircraft and may not assist with any ground activities such as load attachment or removal.

Control 55.3: Ground Personnel

Ensuring ground personnel have appropriate Personal Protective Equipment (PPE).

Ground personnel must wear appropriate PPE including hard hats with chin straps, impact resistant goggles, gloves and where the RPA cannot land to attach/remove a load (or removal cannot be completed remotely) a means of positively communicating with the flight crew.

BARS®
BASIC AVIATION RISK STANDARD

Contact:

BARS Program Office

Flight Safety Foundation
Regional Office
GPO Box 3026
Melbourne, Victoria 3001, Australia

Telephone: +61 1300 557 162

Email: BARS@flightsafety.org
Web: www.flightsafety.org/bars

Flight Safety Foundation
Head Office
701 N. Fairfax Street, Suite 250
Alexandria, Virginia US 22314-2058

Telephone: +1 703 739 6700
Fax: +1 703 739 6708





Version 3, October 2020