Australian Government
Civil Aviation Safety Authority

AU-STS 1: Applicant Response

BVLOS Operations near a Vertical Object(s) with a Controlled Ground Environment

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Reference material

Document type	Title
Publication	JARUS SORA version 2
Regulation	Part 101 Manual of Standards
Guidance Material	Standard Scenario Application and Documents – Guidance Material

Forms

Form Nº.	Title
Form 101-09	Application for RPA flight authorisation

Revision history

Revisions to this manual are recorded below in order of most recent first.

Version Nº.	Date	Parts / sections	Details
1.0	August 2021	All	First issue

Glossary

Acronyms and abbreviations

Acronym / abbreviation	Description
ABS	Australian Bureau of Statistics
ADS-B	Automatic Dependent Surveillance-Broadcast
AEC	Airspace Encounter Category
AGL	Above Ground Level
AMSL	Above Mean Sea Level
ARC	Air Risk Class
ATC	Air Traffic Control
AU-STS	Australian Standard Scenario
BVLOS	Beyond Visual Line of Sight
CASA	Civil Aviation Safety Authority
C2	Command and Control
C3	Command, Control and Communication Link
CONOPS	Concept of Operations
CRM	Crew Resource Management
CTR / CTZ	Control Zone
DAA	Detect and Avoid
EMS	Emergency and Medical Service
ERP	Emergency Response Plan

Acronym / abbreviation	Description
EVLOS	Extended Visual Line of Sight
FLARM	Flight and Alarm
ft	Feet
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HMI	Human Machine Interface
ICAO	International Civil Aviation Organisation
J	Joules
JARUS	Joint Authorities for Rulemaking of Unmanned Systems
kJ	Kilojoules
km	Kilometre
LTE	Long Term Evolution. LTE is a 4G wireless communications standard.
m	Metres
MC	Maintenance Controller
MTOM	Maximum Take-off Mass
NM	Nautical Miles
OEM	Original Equipment Manufacturer
OSO	Operational Safety Objective
Part 101 MOS	Part 101 (Unmanned Aircraft and Rockets) Manual of Standards 2019
ReOC	RPA Operator's Certificate
RP	Remote Pilot
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft Systems
RPIC	Remote Pilot in Command
RPS	Remote Pilot Station
SAIL	Specific Assurance and Integrity Level
SORA	Specific Operation Risk Assessment
TMPR	Tactical Mitigation Performance Requirements
VMC	Visual Meteorological Conditions
VLOS	Visual Line of Sight

Definitions

Term	Definition
Active Participants	Those persons directly involved with the operation of the RPA or fully aware that the RPA operation is being conducted near them. They are fully aware of the risks involved with the RPA operation and have accepted these risks. Active participants are informed on and able to follow relevant effective emergency procedures and / or contingency plans.
Atypical Airspace	Airspace where the unmitigated risk of an encounter between an RPA and a conventionally piloted aircraft is acceptably low. This can be: • restricted airspace (e.g. segregated / restricted areas) • airspace designated 'atypical' by the competent authority • airspace where conventionally piloted aircraft do not routinely fly (e.g. within 120 m from buildings) • airspace characterisation where the collision risk between an RPA and conventionally piloted aircraft is not greater than the target level of safety of 1E-7 Mid Air Collisions (MAC) per flight hour.
Beyond Visual Line of Sight (BVLOS)	An RPAS operation whereby the RPIC is not able to maintain visual unaided contact with the aircraft at all times.
Controlled Ground Environment	is defined as the intended RPA operational area that only involves active participants. The assurance that there will be no non-active participants in the area of operation is under full responsibility of the operator (i.e. Landholder controls access to site).
Dangerous Goods	Articles or substances listed as dangerous goods in the ICAO Technical Instructions, or which are classified according to those instructions.
Extended Visual Line of Sight (EVLOS)	An RPAS operation whereby the RPIC maintains an uninterrupted situational awareness of the airspace and ground environment in which the RPA operation is being conducted via visual airspace surveillance through one or more human observers, possibly aided by technology means.
Improbable	For the purpose of this assessment, this refers to a 'qualitative' interpretation i.e. "unlikely to occur in each RPAS during its total life, but which may occur several times when considering the total operational life of a number of RPAS of this type."
Probable	For the purpose of this assessment, this refers to a 'qualitative' interpretation i.e. "anticipated to occur one or more times during the entire system / operational life of an item."

Term	Definition
Relevant Airspace	Areas and airspace within the no-fly zone of an aerodrome or helicopter landing site, as defined in MOS Part 101. In general terms, for an aerodrome these areas include: • areas and airspace within 3 NM of the movement area of the aerodrome, where the movement area includes areas used for the surface movement of conventionally piloted aircraft, manoeuvring areas and aprons • the approach and departure paths of the aerodrome. For a helicopter landing site, this is the area inside a cylinder with a 1.5 NM diameter and 400 ft height centred on the helicopter landing site.
Relevant Event	occurs when a conventionally piloted aircraft is within relevant airspace, including when an aircraft is landing, taking off, or manoeuvring on the movement area of the aerodrome or helicopter landing site.
Remote Australian Airspace	Airspace defined by CASA as being located in areas that have very low population density and negligible air activity so that these areas can be considered suitable for consideration for RPA BVLOS operations utilising mitigations agreed with CASA.
Remote Pilot in Command (RPIC)	is responsible for the flight and all actions conducted by the operating crew in support of the flight. For BVLOS operations, the RPIC must hold an IREX or CASA approved BVLOS examination pass. Under Exemption CASA EX46/21, the RPIC does not have to be the RP controlling the RPA.
Shielded Operations	An operation of an RPA within a specified distance, typically 120 metres from, and below the top of, a natural or man-made object.
Visual Line of Sight (VLOS)	An RPA is being operated within the visual line of sight if the person operating the aircraft can continually see, orient, and navigate it to meet the person's separation and collision avoidance responsibilities, with or without corrective lenses, but without the use of binoculars, a telescope or other similar device.

1 Introduction

For this standard scenario (AU-STS 1), CASA has undertaken a SORA assessment for a predefined Concept of Operations (CONOPs) for a Beyond Visual Line of Sight (BVLOS) operation near a vertical object(s) with a controlled ground environment. Mitigations and the required documentation to show compliance are specified in this document to achieve an acceptable level of safety. CASA has determined the outcome of this SORA assessment to be a SAIL II.

While not an exhaustive list, the use-cases that fall within this scenario might include inspections or surveillance of infrastructure, such as powerlines, communications towers, wind turbines and / or bridges. This scenario may also cover operations that occur near a vertical object(s) (e.g. a building), but where that object is not the subject or target of the operation. This scenario also requires a controlled ground environment, such as mine sites, wind farms, or other similar locations.

The SORA is clear that the only way to undertake BVLOS operations without some form of 'detect and avoid' (DAA) is to do so in "atypical airspace" which is airspace that is so devoid of aircraft that the chance of randomly encountering another aircraft is so low that it would meet any target level of safety without additional mitigation. This does not mean that CASA will not require any mitigation for air risk in atypical airspace, but that it is rather an indication of the unmitigated risk in the airspace under consideration.

Operating an RPA in close proximity to a vertical object is considered atypical airspace as the operation of conventionally piloted aircraft (also referred to as manned aircraft) in such close proximity to a vertical object would be both hazardous and dangerous.

The following assumptions have been made in the development of this scenario:

(1) The RPA(s) will not be fitted with a DAA system.
(2) No RPA Traffic Management system will be in operation.
(3) RPA to RPA conflicts are not considered.
(4) The applicant will have an Emergency Response Plan (ERP).

Before proceeding with the BVLOS Standard Scenario Application for BVLOS Operations near Vertical Objects with a Controlled Ground Environment (AU-STS 1), applicants should refer to the Standard Scenario Application and Documents – Guidance Material.

Although not mandatory, it may also assist to be familiar with the basic SORA concepts and terminology. The SORA package can be downloaded from the JARUS website.

This STS has not been endorsed by JARUS and is applicable to BVLOS operations in Australian airspace only.

2 Scope

This document is intended to be used as part of the safety case application for a BVLOS approval to conduct BVLOS operations near vertical objects with a controlled ground environment standard scenario. Examples of vertical objects may be buildings, trees, masts, towers, wind turbines, or powerlines, which can be considered individually or as groups e.g. a windfarm.

A controlled ground environment could exist or be established within settings, such as mine sites, wind farms, utilities, or other locations where controls are in place to ensure the overflown area only includes active participants, and where there is a level of assurance that there will be no non-active participants in the area.

The safety case assessment has two distinct phases:

(1) The development of the CONOPS and ensuring that the planned operation complies with this standard scenario. If the CONOPS does not meet the requirements of the standard scenario, there is no benefit in moving on to the second phase.
(2) Development of the procedures and documentation to support the proposed operation.

Figure 1 below provides a visual overview of the ground and airspace attributes for RPAS operations covered within this scenario. These are explained in further detail in Table 1.

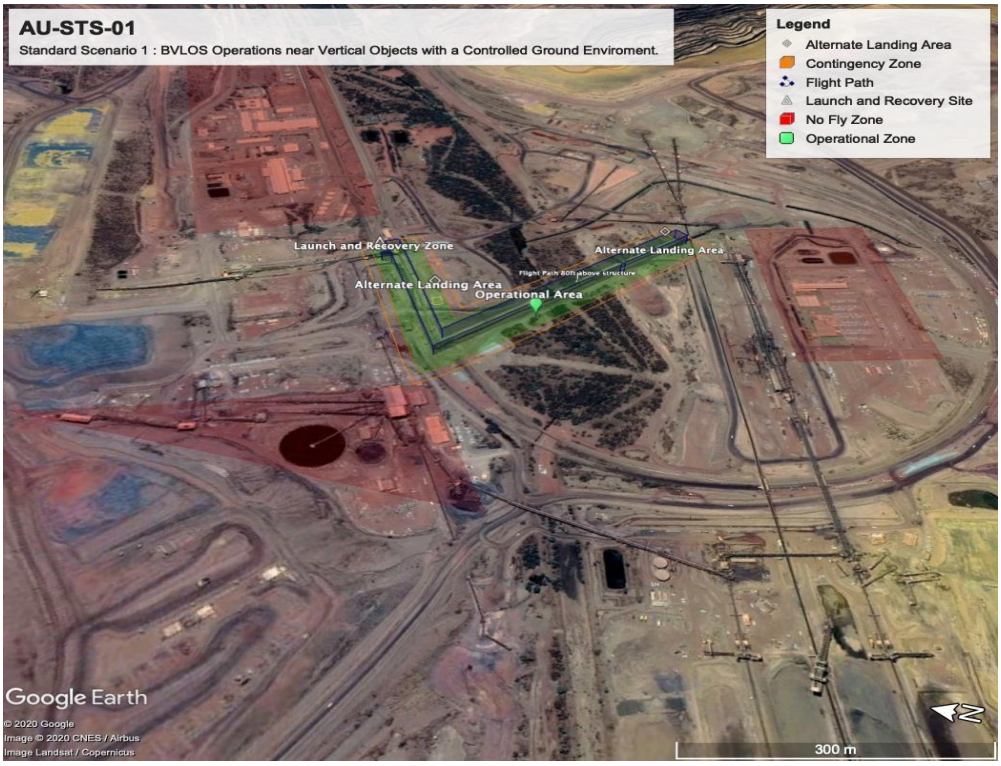


Figure 1: Attributes of AU-STS 1

After reviewing the following information, if the decision is to proceed with an application, review and complete sections 3 and 4 to build a safety case.

2.1 Standard Scenario Characterisation and Provisions

Table 1: Summary of CONOPS assumptions for BVLOS AU STS 1

RPA Operations near vertical objects – Atypical airspace	
Ground risk characteristic – Controlled Environment	
Geographic area – Australia	
Operational characterisation (scope and limitations)	
Level of human intervention	• No autonomous[1] operations: the remote pilot must always be able to intervene during normal operations • The remote pilot must only operate one RPA at a time • Handover of control of the RPA from one pilot to another will be permitted.
Range limit from remote flight crew	• RPAS is operated at a maximum distance of 80% of OEM stated or proven C2 link range from the controller.
Overflown areas	• Controlled Area.
RPAS limitations	• Max. characteristic dimension (e.g. wingspan or rotor diameter / area): < 8 m • Typical kinetic energy up to < 1084 kJ.
Vertical limit	• Within 100 ft of an object.
Horizontal limit	• Within 120 m of an object.
Airspace	• Class C, D or G • Operations in class C or D airspace within 3 NM of a controlled aerodrome or above 400 ft AGL requires Airservices approval (civil) or Department of Defence (RAAF) approval (military airfields) • Operations seeking approval to conduct RPA operations within 3 NM of a certified non-controlled aerodrome need to demonstrate how a relevant event will be safely managed.
Other	• No items may be dropped which cause a hazard • No dangerous goods may be carried unless that item forms part of the RPA itself (e.g. LiPo battery).
Weather	• 5 km visibility (forecast) • 1,000 ft vertically clear of actual cloud base • Not operated within 5 km of thunderstorms or showers.

[1] An operation during which an unmanned aircraft operates without the remote pilot being able to intervene.

Operational mitigations	
Operational Volume	The operational volume comprises the flight geography and the contingency volume. To determine the operational volume, the applicant must consider the position-keeping capabilities of the RPA in 4D space (latitude, longitude, height, and time). In particular, the accuracy of the navigation solution, the flight technical error of the RPA, as well as the path definition error (e.g. map error) and latencies will be considered and addressed in this determination. If the RPAS leaves the operational volume, emergency procedures must be activated immediately.
Ground Risk	A controlled ground area is defined as an operational area that only involves active participants (if any), and there is a level of assurance that there will be no non-active participants in the area. Applicants will need to detail how the area is controlled, for example: • Control of access by personnel or electronic means. • Physical barrier such as fencing. • Entry control briefing conducted. • Signage in place. • No public rights of way through the area etc. While a 1:1 buffer is not a requirement for all RPA operations utilising this AU-STS, applicants should consider those items set out in section 4.3 Containment to ensure the contingency area will be adequate in providing appropriate separation to adjacent ground areas. The operational volume and the ground risk buffer must be wholly within a controlled ground environment. The applicant must have documented practices and procedures that detail how BVLOS operations are planned and show how the flight operational area is managed if any unexpected person or vehicle enters the controlled area. The applicant must detail the expected active participants in: • the Operational Volume (Flight Geography and Contingency) • any ground risk buffer (if applied). The applicant must show population density by using Australian Bureau of Statistics (ABS) data to determine the population density in adjacent surrounding areas.
Air Risk	The operation volume must be in atypical airspace. If adjacent areas are class C or D airspace or military CTR, an air risk buffer must be applied. If the applicant requests BVLOS operations within the relevant airspace of an uncontrolled aerodrome, this part of the operation must be shielded, and aerodrome radio frequencies monitored with radio calls being made as required. If shielded operations are not possible, the operations in the relevant airspace of an uncontrolled aerodrome or in the vicinity of a controlled aerodrome must be conducted as either VLOS or EVLOS operations (if the applicant holds an approval for EVLOS operations). Further approvals in addition to the BVLOS approval may then be required.

	If the applicant requests BVLOS operations with Class C or D airspace including military CTRs, Airservices Australia or the Defence unit controlling the airspace must be consulted (if the proposed operation is above 400 ft AGL, in the approach / departure path or within 3 NM of the movement area of the aerodrome). Such operations must be shielded at all times; radio transmissions and carriage are mandatory regardless of RPA size and the remote pilot must have the ability to monitor cooperative air traffic information (e.g. ADS-B IN receiver, web-based real time aircraft tracking services).
ReOC holder	A CASA ReOC and its associated Operations Manual already cover a substantial amount of the procedural / organisational mitigations required by SORA. The applicant must however develop and document the procedures and processes required to support the specific BVLOS operation. Where required, the applicant may need to demonstrate the efficacy of those procedures to CASA.
RPA operations	The applicant will document the following procedures or policies in their operations manual: • Task-specific BVLOS operational procedures. • Handover procedures from BVLOS to EVLOS / VLOS and vice versa (if required). • Handover procedures between RPs (if required). • Task-specific RPA operational limitations. • Task-specific Emergency Response Plan (ERP). • Limitations of the external systems supporting RPA for safe operations. • Weather / environmental conditions required for safe operation. • How the remote crew can declare themselves fit to operate before conducting any operation. • How the remote crew is assessed as current and competent. • An up-to-date list of remote crew members authorised to carry out BVLOS operations. The adequacy of the contingency and emergency procedures will be proved through: • dedicated flight tests • simulations, provided the representativeness of the simulation means is proven for the intended purpose with positive results, or • any other means acceptable to CASA. A template of BVLOS procedures and sections which may be included in an Operations Manual is provided in Appendix A of Standard Scenario Application and Documents – Guidance Material.
RPAS maintenance	All RPAs used for BVLOS operations will be maintained, as a minimum, in accordance with the OEM documentation. Maintenance records and technical logs for all RPAs to be used for BVLOS operations must be kept in accordance with the Part 101 MOS regardless of size or weight.

External Services	If the applicant relies on any external services, such as LTE (4G / 5G), Internet services etc., the applicant must demonstrate that the performance and availability of the service is adequate for the intended operation. The applicant must document the effects of any degradation or loss of services on the safety of flight and how these will be managed (e.g. operations cease, VLOS / EVLOS only etc.). If the provision of the external service requires specific contracts or arrangements to be entered into, roles and responsibilities between the applicant and the external service provider must be defined. If the applicant is using a standard commercial contract, this is not required (e.g. a mobile phone / data / internet contract).
Training Provisions	
Remote crew	The applicant will document, as a minimum, the following training procedures or policies in their Operations Manual: • Theoretical training syllabus. • Mission planning syllabus. • Practical training syllabus. • BVLOS check flight profile and assessment criteria. • Approved BVLOS trainer qualifications and experience requirements. • Internal training syllabus for BVLOS trainers. • ERP training syllabus. For all BVLOS operations, the remote pilot in command must hold a pass in the IREX or CASA approved examination (CASR 101.300(4)(a)). All remote pilots involved in a BVLOS operation must hold an appropriate aeronautical radio qualification. At a minimum, all remote pilots in command must have at least 20 hours' RPA experience with at least two hours' experience on the type and model of RPA. Applicants should assess whether higher experience levels are required based on the complexity of their RPAS. A record of all relevant qualifications, experience and / or training completed by the remote crew must be established and kept up to date. A template outlining BVLOS training elements which may be included in an Operations Manual is provided in Appendix B of Standard Scenario Application and Documents – Guidance Material.

Technical Provisions	
General	In their Operations Manual, the applicant must document how critical parameters are to be monitored. As a minimum, the applicant will document how: • RPA position, height or altitude, ground speed or airspeed and tracking are monitored • RPA position reference areas and dwellings will be avoided • RPA height reference to the vertical object(s) will be verified • RPA height will be monitored with reference to terrain • the RPA will track around / along the vertical object(s) to maintain the required lateral spacing • RPA energy status (fuel, batteries etc.) • Status of critical functions and systems; as a minimum, for services based on RF signals (e.g. C2 link, GNSS etc.), means must be provided to monitor the adequate performance and triggering an alert if level is becoming too low • interference with C2 or other RPA systems is detected.
Human Machine Interface	The applicant must conduct an evaluation of the RPAS considering and addressing human factors to determine the HMI is appropriate for the BVLOS operations. An HMI assessment proforma is provided in Appendix D of Standard Scenario Application and Documents - Guidance Material. The applicant can either use the template provided as guidance, or put forth an alternative methodology.
Command, Control links (C2) and communication	Any RPA used for BVLOS operations must comply with the appropriate requirements for radio equipment and the use of RF spectrum. In the Operations Manual, the applicant must document the maximum operating range of the RPA from the control station. This can be either 80% of the OEM declared operating range, or a maximum operating range proven by flight operations. In the Operations Manual, the applicant must document how to conduct a visibility / viewshed analysis to demonstrate that the C2 and communication links will not be adversely affected by terrain i.e. electronic line of sight will be maintained throughout the operating area. A copy of the analysis must be attached to all operational releases and provided to CASA as part of any application. The remote pilot must have a reliable and continuous means of two-way radio communication with other air users or ATC if required. The RPICs mobile / satellite phone number and frequency being monitored during flight must be published in the NOTAM for RPA BVLOS operations to allow coordination with unconventionally piloted aircraft and another RPA operator.
Tactical mitigation	The RPA is being operated in atypical airspace so does not have to meet the normal ‘see and avoid’ requirements. A NOTAM must be published for all BVLOS operations, and a radio watch must be maintained.

RPA Conspicuity	The applicant should consider methods to enhance airspace situational awareness, as well as the detectability and conspicuity of the RPA, for example: • technologies for electronic detection of air traffic (e.g. ADS-B IN, web-based real time tracking services) • RPA is fitted with suitable high intensity anti-collision lighting (such as strobes) • RPA is painted using a high visibility colour / contrast paint scheme.
Containment	To ensure a safe recovery from a technical issue involving the RPA, or external system supporting the operation, the applicant should assess and describe the effects of the following probable failures: (1) Ability of RPA to continue to fly or make a safe landing with at least one motor inoperative (i.e. the RPA remains controllable). (2) Intermittent or degraded C2 link particularly at the maximum operating range and / or around vertical obstacles. (3) Indications, RPA response and crew procedures and actions in the event of a permanent loss of the C2 link. (4) Total or partial failure of the remote pilot station affecting such systems as electronic displays, video feeds, internet, manual control interfaces etc. caused by software, hardware, or power failures. (5) Identify any possible single point failures in the RPAS which are critical to the containment of the RPA. (6) Navigation system failures, including degradation or total loss of GPS, IMUs, sensors or cameras, that may result in a reduction in navigation accuracy and / or a loss of available navigation modes. The applicant should then ensure that: • no probable failure of the RPA or any external system supporting the operation will lead to operation outside of the operational volume. • it will be reasonably expected that a fatality will not occur from any probable failure of the RPA or any external system supporting the operation. The applicant must then provide a technical assessment that will demonstrate, at a minimum: • design and installation features (independence, separation, and redundancy) • particular risks (e.g. hail, ice, snow, electro-magnetic interference etc.) relevant to the CONOPs.
Additional Notes	VLOS / EVLOS procedures may be utilised to establish the RPA area of operation. Take-off and landing can be conducted either VLOS / EVLOS or BVLOS, provided the applicant has suitable documented practices and procedures. If operations above 400 ft AGL are required, the applicant must request this approval. The applicant must assess the adjacent air and ground risk to ensure these areas meet the requirements of the standard scenario.

3 Application

The following sections provide applicants with guidance about the minimum information and evidence required to support an application for BVLOS operations according to the standard scenario AU-STS 1.

CASA considers these the minimum requirements for applications under this scenario, and applicants should assess whether higher levels of safety are required based on the complexity of the operation.

3.1 Concept of Operations (CONOPs)

The applicant must provide an outline of the proposed concept of operations, including, at least:

- proposed activity(ies) to be conducted
- RPAs that will be utilised
- confirmation that the Remote Pilot will only fly one RPA at a time
- minimum crew composition and qualifications
- details of flight operational area including contingency area and 1:1 buffer
- explanations as to how the flight operational area will be conducted in a controlled ground environment and within 100 ft vertically and 120 m horizontally of a structure
- confirmation that that the applicant has an applicable emergency response plan (ERP) in place.

CONOPS must be attached as a separate document.

3.2 Ground Risk Considerations

For this standard scenario (AU-STS 1), the operational volume and the ground risk buffer must be located in a controlled ground environment and only involve active participants.

Practices and procedures must be documented and detail how BVLOS operations are planned and conducted, including how flight operations are managed if any unexpected personnel or vehicles enter the controlled ground area.

The applicant must demonstrate that the area is a controlled ground area, the maximum aircraft characteristic dimension is less than eight metres, and the typical kinetic energy of the aircraft is < 1080 kJ.

Step 1: Calculate the kinetic energy of all the RPAs intended for use in this operation. Click on Table 2, which will open an Excel spreadsheet. Items in yellow must be completed. Record the results for each RPA in Table 3.

For an RPA to be used in this standard scenario, it must have the following characteristics:

- max. characteristic dimension (e.g. wingspan or rotor diameter / area): < 8 m
- typical kinetic energy: up to < 1084 kJ.

No RPAs that exceed these maximums can be included in this application. If their use is essential, use a different STS or make a full SORA application.

The outcome of this step is a list of RPAs seeking approval for this operation.

For each category of RPA, the maximum characteristic dimension is determined on:

- FIXED-WING AIRCRAFT / POWERLIFT = wingspan

- MULTICOPTERS = maximum dimension
- ROTORCRAFT = rotor diameter.

For the purposes of calculating the typical kinetic energy expected of an RPA, the following formula can be used:

$$KE = \frac{1}{2}\, m\, V^2$$

Where:

- *KE* is the typical kinetic energy (J)
- *m* is the mass of the RPA (kg) – the Maximum Take-off Mass (MTOM) of the RPA is to be used in this case
- *V* is the velocity of the RPA (m/s) – the maximum cruise velocity of the RPA is to be used in this case.

Table 2: Determination of RPA Kinetic Energy

Determination of RPA Kinetic Energy

Kinetic Energy		
Mass		kg
Maximum dimension		m
Aircraft Type		
Make		
Model		
Speed to use	Cruise	
Speed*		m/s
KE		J

Table 3: RPA Characteristics and Typical Kinetic Energy

RPA Characteristics and Typical Kinetic Energy		
RPA Type	**Characteristic Dimension(m)**	**Kinetic Energy(kJ)**

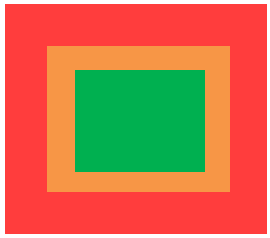
Step 2: Plan the operation including heights, operational volume and apply any ground risk buffer (if required). Ensure the flight route is within 120 m horizontally and 100 ft vertically of a structure unless operating VLOS / EVLOS for this portion. Flight area must include an area for an RPA issue called a contingency area.

Those elements outlined within Step 8 – Containment should also be consulted to help inform the determination and suitability of a proposed contingency area, or if an additional risk buffer will be required.

Figure 2: Flight operational volume

Flight operational volume includes:

- Nominal Flight path / area
- Contingency area
- A 1:1 buffer will then need to be applied.



The outcome is an identified flight operational volume (nominal flight area and contingency area) and the risk buffer.

Note: 1:1 buffer would mean if the RPA is planned to operate at 120 m height, the ground risk buffer should at least be 120 m. An example of this can be seen in section 3 of Standard Scenario Application and Documents - Guidance Material.

Table 4: Flight operational area

Flight Operational Area	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
A geographic data file (e.g. a kml / kmz readable in Google Earth) including: • RPA Flight heights • flight operational volume • ground risk buffer (if required) • identification of any critical infrastructure or sensitive areas (e.g. environmentally sensitive). An example of this is in section 3 of Standard Scenario Application and Documents – Guidance Material.	

Step 3: Using the identified flight operation area, determine whether the flight operational area and ground risk buffer (if applied) is wholly within a controlled ground area.

Practices and procedures must be documented and detail how BVLOS operations are planned and conducted, and how the flight operation is managed if any unexpected personnel or vehicles enter the controlled ground area.

Applicants must outline the expected non-active participants in both the flight operational area and ground risk buffer (if applied).

By using the Australian Bureau of Statistics (ABS) data, applicants must also determine the population density in the adjacent surrounding areas.

The outcome is:

- an updated geographic file or image of the flight operational area and ground risk buffer (if applied) which shows the area is located in a controlled ground environment, and
- updated procedures / or risk assessment on how the proposed operation will be maintained within a controlled ground environment.

Table 5: Controlled ground area

Controlled Ground Area	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
Details of how the proposed operations are in controlled ground area, for example: • Control of access by personnel or electronic means. • Physical barriers such as fencing. • Entry control briefings. • Signage. • No public right of way through it.	
Details on any expected non-active participants in flight operational area and any ground risk buffer (if applied). This should outline a plan to manage the presence of any non-active participants to ensure the area remains a controlled ground area e.g. strategically planning time of operations to coincide with the area being devoid of non-active participants.	
An updated geographic file or image that shows the controlled ground areas.	
Details on population density for proposed adjacent areas.	

3.3 Air Risk Considerations

Step 4: Review the airspace around the flight operation area to identify if any adjacent areas (2 NM around the 1:1 buffer boundary) contain any airspace, danger areas or restricted areas that may support increased levels of aircraft activity or air traffic using this airspace. Applicants

must also ensure that the operation does not take place within the no-fly zone of an aerodrome or helicopter landing site.

The outcome of this step is to provide an image, chart or screenshots that shows the operation is within the scope of this standard scenario and that the operational volume is:

- within both 100 ft vertically and 120 m horizontally of a structure
  and not within:
  - Class C, D or Military CTR
  - 3 NM of the movement area of an aerodrome and / or helicopter landing site.

An example of this is shown in section 3 of Standard Scenario Application and Documents – Guidance Material.

Finally, if an applicant's review of the operating area identifies additional air considerations, these must be addressed and all the applicable actions below must be completed:

- If adjacent areas are class C / D airspace or military CTR, an air risk buffer must be applied. The air risk buffer will vary depending on the RPA type and performance i.e. can it glide, how is it controlled etc.
- If the planned operations will be within the relevant airspace of a non-controlled aerodrome, stakeholder engagement must be completed (refer to Standard Scenario Application and Documents – Guidance Material) and this part of the operation must be shielded, and radio broadcasts made. Operations seeking approval for within 3 NM of the movement area of a certified non-controlled aerodrome need to demonstrate how a relevant event will be identified and managed.
- If planned operations are within Class C / D airspace or military CTR, Airservices Australia or Defence controlling authority must be consulted if the proposed operation is above 400 ft AGL or within 3 NM of the movement area of the aerodrome. Such operations must be shielded at all times, radio transmissions and carriage are mandatory regardless of RPA size, and the remote pilot has the ability to monitor electronically conspicuous air traffic information (e.g. ADS-B IN receiver, web-based real time aircraft tracking services).

If shielded operations are not possible, the operations in the relevant airspace of a non-controlled aerodrome, or in the vicinity of a controlled aerodrome, must be conducted as either VLOS or EVLOS (if the applicant holds an approval for EVLOS operations).

Although not required as part of this standard scenario, applicants are encouraged to adopt any mechanism that may further reduce the risk of a loss of safe separation, such as:

- electronic visibility (i.e., ADS-B, FLARM, transponder)
- lighting, strobes
- high visibility paint.

Table 6: Air risk considerations

Air Risk Considerations	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
Provide an image or geographic data file to show that RPA operations are maintained within both 100 ft vertically and 120 m horizontally of a structure.	
Provide an image, chart or screenshots that show the operation area is within the scope of this standard scenario and not within: • Class C, D or Military CTR • 3 NM of the movement area of any aerodromes and / or 1.5 NM of Helicopter landing sites. If an operation falls within these areas, the following items must also be completed. Put N/A if the operation does not fall in these areas.	
If adjacent areas are in class C / D airspace or military CTR, an air risk buffer must be determined. Applicants must provide an image that includes the flight operational area and an air risk buffer[2].	
If the planned operations are to be within the relevant airspace of a non-controlled aerodrome, applicants must complete a stakeholder engagement plan (refer to Standard Scenario Application and Documents – Guidance Material) and include it in the submission.	
If this planned operation is within the relevant airspace of class C / D, Military CTR or controlled aerodrome, this part of the flight operation must be shielded, and radio broadcasts made. This will need to be included to the image or data file that showcases that the applicant conducts shielded operations. Procedures including radio transmissions and operational ADS-B IN must be provided and utilised.	

[2] While there is currently no prescribed separation minimum for RPA in this context, the determination of any tolerance or buffer to be applied to an adjacent airspace volume would involve consideration of a number of elements, including:

- the airspace classification of the adjacent airspace, the nature of that airspace and the activities being conducted within that airspace
- the flight performance and characteristics of the RPA
- the position keeping and navigational capabilities of the RPA
- the robustness of any measures to ensure containment within the desired RPA flying area, or mitigate loss of containment (e.g. possible single point failures, system redundancies, modes of operation and loss of GNSS or C2 events, any latencies in identifying loss of containment or enacting fail safes etc.)
- any applicable separation distance or provision deemed appropriate by the airspace controlling authority (strategic or tactical measures).

Air Risk Considerations	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
For operations within 3 NM of the movement area or within Approach and Departure of a certified non-controlled aerodrome, in the Operations Manual applicants must detail how a relevant event will be managed.	

3.4 Confirmation

Step 5: The previous steps assessed the proposed BVLOS operation against this standard scenario.

If able to answer YES to the following questions with supporting evidence, complete the next three sections and provide supporting documents.

Table 7: AU-STS 1 checkpoint

Check Points	Yes	No
Is the proposed operation within 120 m horizontally and 100 ft vertically of a structure?		
Are the RPA characteristics less than 8 m and kinetic energy less than 1084 kJ?		
Can a controlled ground area be established?		

If the answer is NO to any of the questions above, applicants must either:

- amend planned operations to fit the operational characteristics of this standard scenario
- check planned operations against a difference standard scenario, or
- complete a full BVLOS SORA application (more information on this process can be obtained from rpas@casa.gov.au).

4 Additional Supporting Materials

4.1 Operational Procedures

Step 6: Provide the following operational procedures and documentation:

(1) An updated Operations Manual for BVLOS operations, including BVLOS procedures, training and record keeping.
(2) An Emergency Response Plan.
(3) A completed HMI assessment of all RPAs and RPS.
(4) A completed stakeholder engagement plan for aerodromes (if required).

To assist in developing these documents, examples are provided in Standard Scenario Application and Documents – Guidance Material.

4.2 Additional mitigations

Step 7: Document additional mitigations and provide references for any evidence being providing as support for the application. This is divided into three sections, and they must all be completed:

- Operator Provisions
- Training Provisions
- Technical Provisions.

The outcome of this step is a safety case that supports the application.

Table 8: Additional mitigation - Operator provisions

Operator Provision	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
Chief pilot record keeping needs to be updated to include items for BVLOS in accordance with MOS Part 101, including: • RPAS operational release • RPAS operational log • Remote Pilot log.	
A list of remote crew members authorised to carry out BVLOS operations which must be current.	
Schedule 1 must be current and also list RPAs that are authorised for this BVLOS standard scenario. Refer to Standard Scenario Application and Documents – Guidance Material.	
Provide provisions or policy in the Operations Manual defining how the remote crew can declare themselves fit to operate before conducting any operation.	

Operator Provision	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
Provide documented procedures for accepting a new RPA into BVLOS operational use. Refer to Standard Scenario Application and Documents – Guidance Material.	
Minimum of OEM pre- / post-flight checks documented or referenced in Operations Manual.	
Operational procedures for BVLOS that cover: • flight planning • weather • normal and emergency procedures • occurrence reporting • any relevant RPA operational limitations.	
Radio line of sight viewshed analysis or C2 electronic LOS for the operating area.	
Record of ERP validation (tabletop exercise).	

Table 9: Additional mitigations - Training

Training	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
Type training including the acceptance of RPAs into operation (product inspection / conformity) to be added to the Operations Procedures for all RPA that will be utilised in this standard scenario.	
ERP training syllabus must be available. An example is provided at Appendix B of Standard Scenario Application and Documents – Guidance Material. A record of internal ERP training completed by the relevant staff must be established and kept up to date, and Training records kept in accordance with MOS Part 101.	
All RPs hold RePL with appropriate RPA operating privileges (Category / Weight Class).	
Training and procedures for multi crew operations must be documented in Operations Manual.	
Operations Manual must document training for operation of flight critical support equipment.	

Table 10: Operational mitigations - Technical

Technical	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
Demonstrate the RPA will be operated within 80% of the specified OEM range and determine the RF spectrum usage and environmental conditions for C3 links are adequate to safely conduct the intended operation, including: • detailed procedures in Operations Manual • RPA range is listed in Schedule 1 of Operations Manual. Applicants may also illustrate expected RPA operating range in the geographic data file (readable in Google Earth).	
Show that all RPAs used for BVLOS operations will be maintained in accordance with the OEM documentation. Maintenance records and technical logs for all RPAs to be used for BVLOS operations must be kept in accordance with MOS Part 101 regardless of size or weight. If the RPA is to be operated in the vicinity of high intensity radio transmissions or similar, the applicant must detail how RPA operations will be safely conducted within this environment.	
A self-declared HMI assessment is attached as part of this submission. It includes equipment that has been reviewed and considered fit for purpose. HMI assessment completed in accordance with Appendix D Standard Scenario Application and Procedures – Guidance Material.	
If required, how external services are used and assured must be documented in the Operations Manual.	
Provide maintenance procedures for any flight critical support equipment	
In Operations Manual, document how weather limits are defined and how these are monitored.	

4.3 RPA Containment

Step 8: To ensure a safe recovery from a technical issue involving the RPA, or external system supporting the operation, applicants should assess and describe the effects of the following probable failures:

(1) Ability of RPA to continue to fly or make a safe landing with at least one motor inoperative (i.e. the RPA remains controllable) where applicable.
(2) Intermittent or degraded C2 link particularly at the maximum operating range and / or around vertical obstacles.
(3) Indications, RPA response and crew procedures / actions in the event of a permanent loss of the C2 link.
(4) Total or partial failure of the remote pilot station affecting such systems as electronic displays, video feeds, internet, manual control interfaces etc. caused by software, hardware, or power failures.
(5) Identify any possible single point failures in the RPAS which are critical to the containment of the RPA.
(6) Navigation system failures, including degradation or total loss of GPS, IMUs, sensors or cameras, that may result in reducing navigation accuracy and / or a loss of available navigation modes.
(7) Flight planning failures that could result in a loss of containment (i.e. incorrect setting of waypoints / RTH function).

Outcome: Provide an analysis of the RPAS that demonstrates that:

- no probable failure of the RPA or any external system supporting the operation will lead to operation outside of the flight operational area and 1:1 buffer
- it will be reasonably expected that a fatality will not occur from any probable failure of the RPA or any external system supporting the operation.

Attach supporting evidence and documentation.

5 Submitting an Application

The completed BVLOS application package should include:

(1) completed application for RPA flight authorisation (CASA Form 101-09)
(2) completed AU-STS 1 Applicant Response document with all supporting attachments including KML files, maps, images, analysis, ERP plans, HMI Assessments, and stakeholder engagements, and
(3) updated CASA Operations Manual Suite.

The completed BVLOS application including all supporting documentation should be submitted to rpas@casa.gov.au. If the total file size exceeds 18 MB, contact the RPAS Team first to make alternative arrangements for submitting the application.

On receipt of a completed application, CASA will calculate and issue an estimate of the cost to process the application. The estimate must be paid before any assessment can be undertaken.

Due to the high volumes of BVLOS applications submitted to CASA, ensure completed applications are lodged well in advance of the operation's proposed start date.