



Australian Government
Department of Defence
Capability Acquisition and
Sustainment Group



MIRRAGIN
AEROSPACE CONSULTING

Unmanned Aerial Systems Management Unit

ADF Unmanned Aerial Systems Safety Management System
August 2018



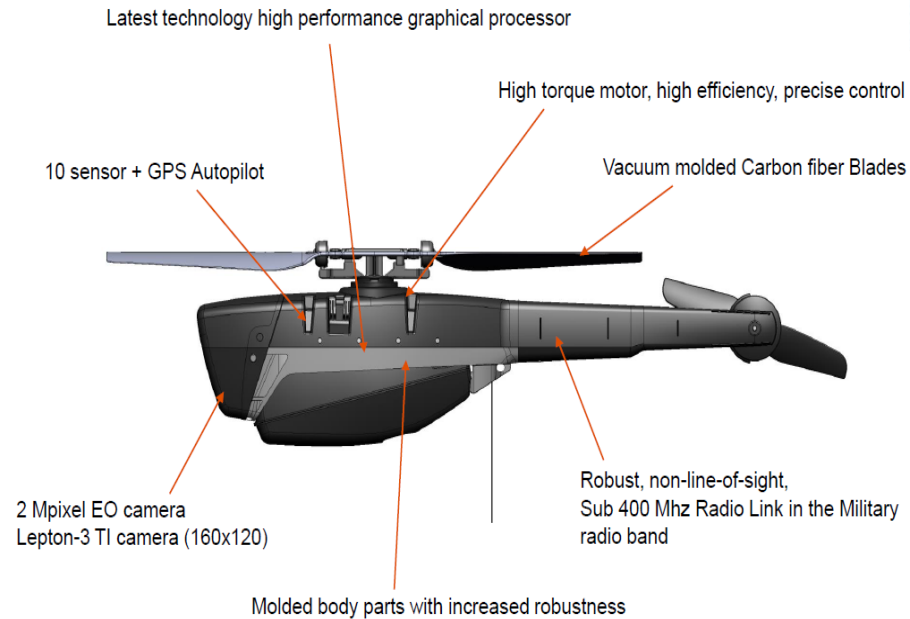
Objective:

- Create a safety management framework for the current & future ADF UAS, which ensures:
 - Safety
 - Fitness for Purpose

Guiding Principles:

- Keep it simple
- Eliminate waste
- Consider full spectrum of ADF UAS
- Enable innovation & rapid change

Micro-UAS Exemplar Systems: BH3 & FPV Racer

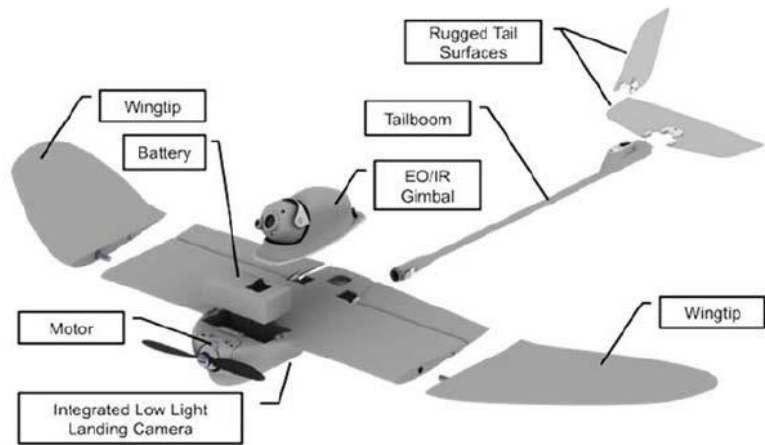


Black Hornet 3 – Air vehicle weight: 18 grams



Cheerson Tiny 117 FPV Racer – Air vehicle weight: 90 grams

Very Small-UAS Exemplar Systems: WASP AE & DJI Phantom 4



WASP AE - Air vehicle weight: 430g



DJI Phantom 4 - Air vehicle weight: 1380g

Small-UAS Exemplar Systems: Puma & ScanEagle



PUMA AE - Air vehicle weight: 5.9 kg



Scan Eagle - Air vehicle weight: 18 kg

Medium UAS Exemplar Systems: S100D



Schiebel S100D - Air vehicle weight: 110 kg

Large UAS Exemplar Systems: Shadow & Fire Scout



RQ-7B Shadow V1- Air vehicle weight: MTOW ~210kg



MQ-8B Fire Scout - Air vehicle weight: 1,430 kg

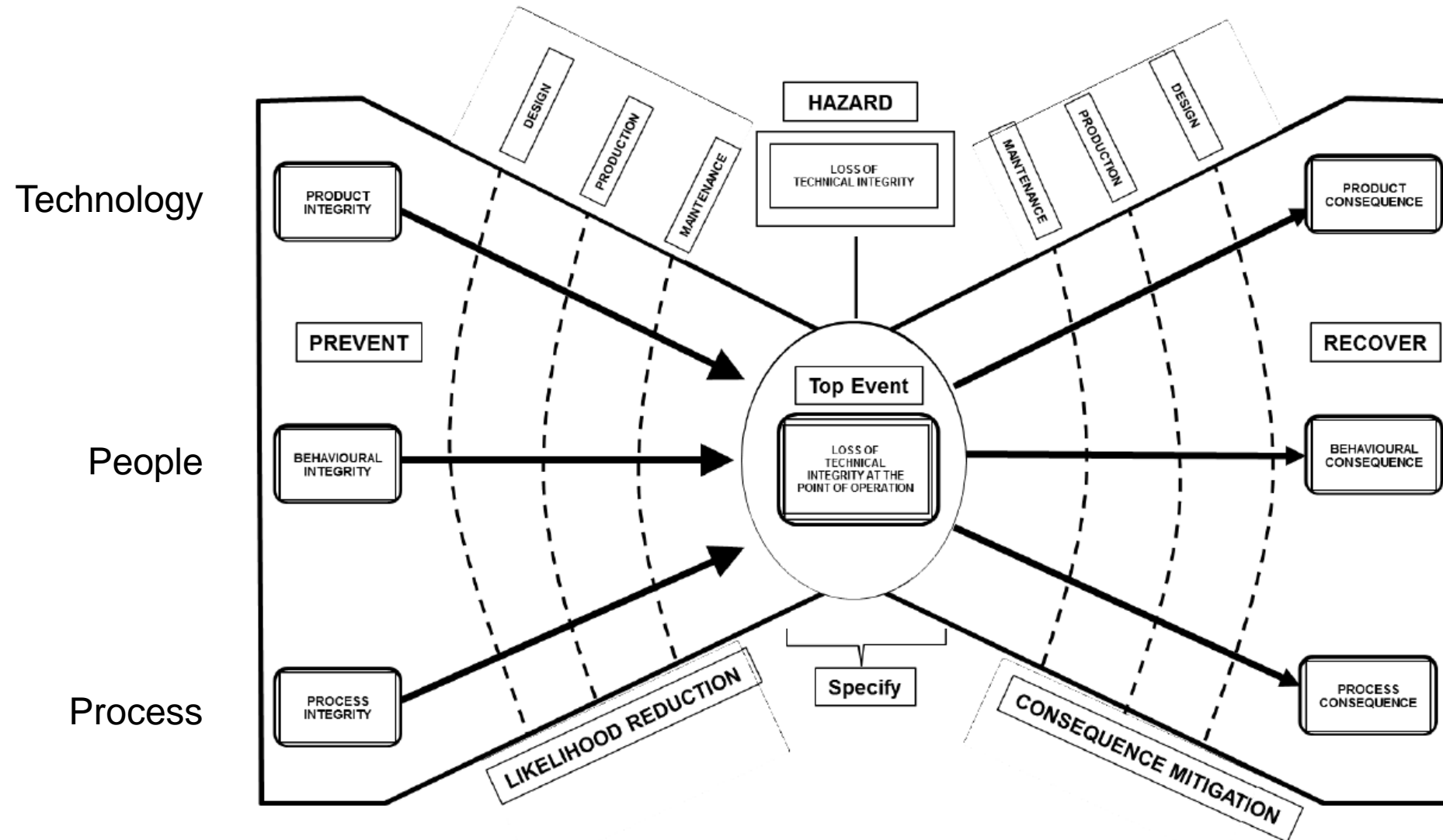
Existing Regulations

- DASR.UAS
- Australian WHS Act 2011

Risk Methodology

- Bowtie Methodology using barriers & controls

Risk Methodology – Bowtie Model



Source: <https://researchbank.rmit.edu.au/eserv/rmit:161035/Purton.pdf>

Generic risk assessments

- Micro UAS
- Very Small UAS
- Small UAS
- Medium UAS
- Large UAS

Micro-UAS Risk Assessment Outcomes

ID	Title	Description	Causes	Consequences	Class	Likelihood	Consequence	Original Risk Level	Residual Likelihood	Residual Consequence	Residual Risk Level
1	Mechanical Injury	There is a chance that personnel in the area of operations of the Micro-UAS could be injured by the main rotor or tail rotor, most likely leading to an eye or finger injury	(1) Physical contact with the rotor blades (2) Debris thrown by micro UAS (e.g. dirt, small rocks).	Worst case is permanent blindness in one eye (permanent partial disability), however this injury would be highly unlikely. Minor injuries requiring first aid would be likely.	People	Occasional	Major	C3	Rare	Major	C1
2	Impact injury	There is a chance that personnel in the area of operations of the Micro-UAS could be injured by a physical impact with the micro UAS, leading to bruising	(1) Physical impact with Micro UAS	Minor injury such as bruising, which could result in first aid or minor supportive medical treatment.	People	Occasional	Minor	A3	Improbable	Minor	A2
3	Ergonomic Injury	There is a chance that personnel operating the UAV or receiving data could sustain long term injuries due to poor posture whilst operating the micro UAS Ground Control Station	(1) Poor posture whilst operating the Ground Control Station or the Remote Viewing Terminal (2) Inadequate design of controller	Could result in temporary partial disability less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation.	People	Rare	Major	C1	Rare	Major	C1
5	Vertigo/dizziness	There is a chance that personnel operating the UAV or receiving data could sustain vertigo or dizziness due to conflicts between the received video & ground motion	(1) Inadequate design of controller (2) Inadequate training (3) Individual characteristics (some people are more susceptible, especially when ill)	(1) There could be minor injuries that are treated at the site with no long-term effects. (2) There could be a temporary loss of mission capability whilst the operator is ill.	People	Probable	Minor	A4	Rare	Minor	A1
6	Electrical injury	There is a chance that personnel operating or maintaining the UAV could be exposed to the risk of electrical shock or thermal burn, resulting in injury.	(1) Inadequate design of air vehicle or system components (2) Operating the unit whilst defective	At the DC voltages normally seen in small electrical items, could result in first aid or minor supportive medical treatment. Ancillary equipment, such as chargers, operate on 240V AC and a malfunction may cause electrocution, leading to death.	People	Occasional	Critical	D3	Rare	Major	C1
7	Radiation injury	There is a chance that personnel operating or maintaining the UAV could be exposed to a radiation hazard, resulting in injury.	(1) Inadequate design of air vehicle or system components (2) Operating the unit whilst defective	Could result in temporary partial disability less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation.	People	Improbable	Moderate	B2	Rare	Minor	A1
8	Noise injury	There is a chance that personnel operating or maintaining the UAV could be exposed to excessive noise, leading to a hearing injury	(1) Inadequate design of air vehicle or system components (2) Operating the unit whilst defective	This is extremely unlikely given the small size of the air vehicles involved. However, it could result in permanent hearing damage (permanent disability) which may be eligible for compensation.	People	Improbable	Major	C2	Rare	Moderate	B1
14	Hazardous Substances	There is a chance that drilling into, damaging or burning the air vehicle or other system components may release hazardous substances, including carbon fibre or glass fibre	(1) Inadequate design of air vehicle or system components (2) Inappropriate maintenance (3) Incident involving damage, explosives or fire	Ingestion of hazardous substances could result in temporary partial disability less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation, or short term damage to the environment which is rectifiable.	Environment	Occasional	Moderate	B3	Rare	Moderate	B1
15	Battery fire	There is a chance that the system batteries may spontaneously combust, causing a fire or releasing hazardous substances	(1) Inadequate design of air vehicle or system components (2) Operating the unit whilst defective (3) Operating, storage or transport of the battery outside design limitations (4) Inherent nature of chemical battery types	A fire on board an aircraft, ship or other major equipment type could result in total loss, including loss of life.	Environment	Improbable	Catastrophic	E2	Rare	Major	C1
17	Starts bushfire	There is a chance that the operation or crash of an air vehicle may lead to a bush fire	(1) Spark from impact of air vehicle into solid object (2) Spark from electrical system (including battery)	Damage to reputation at DoD. Risk of fire damage to property Risk of injury or death caused by fire to personnel Associated legal liability	Environment	Rare	Catastrophic	E1	Rare	Moderate	B1
18	Disposal hazards	There is a chance that the Micro-UAS system may cause an environmental hazard when disposed (which may include abandonment)	(1) Hazardous substances in propulsion system (battery or fuel) (2) Hazardous materials used in the construction of the system	Hazardous materials may cause environmental pollution, such as air pollution or water system pollution, if they leach out of the system components or are otherwise released into the environment	Environment	Occasional	Minor	A3	Rare	Minor	A1
19	Component failure	There is a chance that some component of the Micro-UAS system becomes unserviceable, causing the aircraft to be unavailable for its mission	(1) Inadequate design of air vehicle or system components (2) Inappropriate maintenance (3) Incident involving damage, explosives or fire	Temporary loss of mission capability whilst unserviceable component is repaired	Assets	Almost Certain	Moderate	B5	Occasional	Minor	A3
20	Loss of air vehicle	There is a chance that a Micro-UAS system becomes lost, resulting in financial damage.	(1) Loss of control (2) Weather implications (3) Disorientation (4) Deliberate hostile action	Financial loss equal to the replacement cost of the asset (may be in the range \$100k - \$1M) Loss of capability until asset can be replaced. Exposure of personnel to more risk to gather required data whilst air vehicle is unavailable	Assets	Probable	Moderate	B4	Improbable	Moderate	B2
21	Damage to other aircraft	There is a chance that a Micro-UAS could cause damage to another aircraft, including by being injected into an engine, causing damage to that aircraft.	(1) In flight collision (2) Inadequate airspace awareness (3) Deliberate hostile action (4) Disorientation (5) Weather implications	Inability to achieve one or more of the significant requirements of the impacted aircraft, significantly degrading the system's ability to perform primary mission.	Assets	Improbable	Catastrophic	E2	Rare	Major	C1
22	Damage to buildings / property	There is a chance that a Micro-UAS could cause damage to buildings or property through impact or debris damage	(1) In flight collision (2) Inadequate airspace awareness (3) Deliberate hostile action (4) Disorientation (5) Weather implications	The damaged property or building is functionally fit for all desired missions or tasks, but there may be some qualification to the level to which it would perform non-critical elements of the mission or task. Likely cost to rectify damage <\$100k or repair time <2 days	Assets	Occasional	Minor	A3	Rare	Minor	A1
23	Inaccurate / incorrect data	There is a chance that data coming from the Micro-UAS (e.g. position information) is incorrect or inaccurate, leading to difficulties processing the data	(1) Poor design of payload (2) Poor design of aircraft systems (3) Poor design of datalink (4) Deliberate hostile action (cyber attack, jamming, spoofing).	Inability to achieve one or more of the significant requirements of the Mission System (or lower level equivalent), significantly degrading the system's ability to perform primary mission (decision support).	Assets	Occasional	Moderate	B3	Rare	Minor	A1
24	Security of data	There is a chance that imagery/data transmitted from the Micro-UAS can be intercepted, resulting in a security breach or possible compromise of operations	(1) Hostile intercept (2) Inadequate security controls on data (3) Inappropriate usage of Micro-UAS	Would cause damage, security incident possibly involving compromise, loss or unauthorised disclosure of classified or sensitive information, equipment, strategy or tactics that affects capability and functionality	Reputation	Probable	Moderate	B4	Rare	Moderate	B1
25	Spectrum usage	There is a chance that the Micro-UAS will inappropriately use the wrong frequency, causing interference with other agencies	(1) Inadequate design of system (2) Inadequate control of spectrum by SPO / Defence	Damage to reputation at Executive level.	Reputation	Improbable	Moderate	B2	Rare	Moderate	B1
26	Theft / hijacking	There is a chance that the Micro-UAS can be stolen or hijacked and inappropriately operated	(1) Inadequate design of system (2) Hostile action (3) Lack of security measures	Would cause damage, security incident possibly involving compromise, loss or unauthorised disclosure of classified or sensitive information, equipment, strategy or tactics that affects capability and functionality, or damage to reputation at Executive level.	Reputation	Improbable	Moderate	B2	Rare	Moderate	B1
27	Not fit for service	There is a chance that the Micro-UAS is unable to meet its operational requirement set.	(1) Inadequate requirements definition (2) Inadequate Validation	Inability to achieve any missions. This may have serious unit / tactical implications, or represent a waste of the procurement spend	Reputation	Occasional	Major	C3	Rare	Major	C1

20 threats identified.

Pre-mitigation max risk level: High (x1)

Post mitigation max risk level: Very Low.

Note: mitigations are generic in nature at this point and still need to be placed in a working system

Very Small UAS Risk Assessment Outcomes

ID	Title	Description	Causes	Consequences	Likelihood	Consequence	Original Risk Level	Residual Likelihood	Residual Consequence	Residual Risk Level
1	Mechanical Injury	There is a chance that personnel in the area of operations of the Very Small UAS could be injured by the rotors, most likely leading to an eye or finger injury	(1) Physical contact with the rotor blades (2) Debris thrown by UAS (e.g. dirt, small rocks).	Worst case is permanent blindness in one eye (permanent partial disability), however this injury would be highly unlikely. Minor injuries requiring first aid would be Likely.	Occasional	Major	C3	Rare	Major	C1
2	Impact injury	There is a chance that personnel in the area of operations of the Very Small UAS could be injured or killed by a physical impact with the air vehicle.	(1) Physical impact with Very Small UAS	A 2kg drone, flown into a person at speeds of greater than 36 km/hr will likely cause unacceptably severe injury, and at maximum speed (~75 km/hr) may cause death.	Probable	Critical	D4	Rare	Critical	D1
3	Ergonomic Injury	There is a chance that personnel operating the UAV or receiving data could sustain long term injuries due to poor posture whilst operating the UAS Ground Control Station	(1) Poor posture whilst operating the Ground Control Station or the Remote Viewing Terminal (2) Inadequate design of controller	Could result in temporary partial disability less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation.	Rare	Major	C1	Rare	Major	C1
5	Vertigo/dizziness	There is a chance that personnel operating the UAV or receiving data could sustain vertigo or dizziness due to conflicts between the received video & ground motion	(1) Inadequate design of controller (2) Inadequate training (3) Individual characteristics (some people are more susceptible, especially when ill)	(1) There could be minor injuries that are treated at the site with no long-term effects. (2) There could be a temporary loss of mission capability whilst the operator is ill.	Probable	Minor	A4	Improbable	Minor	A2
6	Electrical injury	There is a chance that personnel operating or maintaining the UAV could be exposed to the risk of electrical shock or thermal burn, resulting in injury.	(1) Inadequate design of air vehicle or system components (2) Operating the unit whilst defective	At the DC voltages normally seen in small electrical items, could result in first aid or minor supportive medical treatment. Ancillary equipment, such as chargers, operate on 240V AC and a malfunction may cause electrocution, leading to death.	Occasional	Critical	D3	Rare	Major	C1
7	Radiation injury	There is a chance that personnel operating or maintaining the UAV could be exposed to a radiation hazard, resulting in injury.	(1) Inadequate design of air vehicle or system components (2) Operating the unit whilst defective	Could result in temporary partial disability less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation.	Improbable	Moderate	B2	Rare	Moderate	B1
8	Noise injury	There is a chance that personnel operating or maintaining the UAV could be exposed to excessive noise, leading to a hearing injury	(1) Inadequate design of air vehicle or system components (2) Operating the unit whilst defective	This is extremely unlikely given the small size of the air vehicles involved. However, it could result in permanent hearing damage (permanent disability) which may be eligible for compensation.	Improbable	Major	C2	Rare	Major	C1
14	Hazardous Substances	There is a chance that drilling into, damaging or burning the air vehicle or other system components may release hazardous substances, including carbon fibre or glass fibre	(1) Inadequate design of air vehicle or system components (2) Inappropriate maintenance (3) Incident involving damage, explosives or fire	Ingestion of hazardous substances could result in temporary partial disability less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation, or short term damage to the environment which is rectifiable.	Occasional	Moderate	B3	Rare	Moderate	B1
15	Battery fire	There is a chance that the system batteries may spontaneously combust, causing a fire or releasing hazardous substances	(1) Inadequate design of air vehicle or system components (2) Operating the unit whilst defective (3) Operating, storage or transport of the battery outside design limitations (4) Inherent nature of chemical battery types	A fire on board an aircraft, ship or other major equipment type could result in total loss, including loss of life.	Occasional	Catastrophic	E3	Rare	Major	C1
17	Starts bushfire	There is a chance that the operation or crash of an air vehicle may lead to a bush fire	(1) Spark from impact of air vehicle into solid object (2) Spark from electrical system (including battery)	Damage to reputation at DoD. Risk of fire damage to property Risk of injury or death caused by fire to personnel Associated legal liability	Rare	Catastrophic	E1	Rare	Moderate	B1
18	Disposal hazards	There is a chance that the UAS may cause an environmental hazard when disposed (which may include abandonment)	(1) Hazardous substances in propulsion system (battery or fuel) (2) Hazardous materials used in the construction of the system	Hazardous materials may cause environmental pollution, such as air pollution or water system pollution, if they leach out of the system components or are otherwise released into the environment	Occasional	Minor	A3	Rare	Minor	A1
19	Component failure	There is a chance that some component of the UAS becomes unserviceable, causing the aircraft to be unavailable for its mission	(1) Inadequate design of air vehicle or system components (2) Inappropriate maintenance (3) Incident involving damage, explosives or fire	Temporary loss of mission capability whilst unserviceable component is repaired	Almost Certain	Moderate	B5	Improbable	Moderate	B2
20	Loss of air vehicle	There is a chance that a Very Small UAS air vehicle becomes lost, resulting in financial damage.	(1) Loss of control (2) Weather implications (3) Disorientation (4) Deliberate hostile action	Financial loss equal to the replacement cost of the asset (may be in the range \$100k - \$1M) Loss of capability until asset can be replaced. Exposure of personnel to more risk to gather required data whilst air vehicle is unavailable	Probable	Moderate	B4	Improbable	Moderate	B2
21	Damage to other aircraft	There is a chance that a Very Small UAS air vehicle could cause damage to another aircraft, including by being injected into an engine, causing damage to that aircraft.	(1) In flight collision (2) Inadequate airspace awareness (3) Deliberate hostile action (4) Disorientation (5) Weather implications	Inability to achieve one or more of the significant requirements of the impacted aircraft, significantly degrading the system's ability to perform primary mission.	Occasional	Critical	D3	Rare	Critical	D1
22	Damage to buildings / property	There is a chance that a Very Small UAS could cause damage to buildings or property through impact or debris damage	(1) In flight collision (2) Inadequate airspace awareness (3) Deliberate hostile action (4) Disorientation (5) Weather implications	The damaged property or building is functionally fit for all desired missions or tasks, but there may be some qualification to the level to which it would perform non-critical elements of the mission or task. Likely cost to rectify damage \$100k to \$1M or repair time 2-14 working days	Probable	Moderate	B4	Rare	Moderate	B1
23	Inaccurate / incorrect data	There is a chance that data coming from the UAS (e.g. position information) is incorrect or inaccurate, leading to difficulties processing the data	(1) Poor design of payload (2) Poor design of aircraft systems (3) Poor design of datalink (4) Deliberate hostile action (cyber attack, jamming, spoofing).	Inability to achieve one or more of the significant requirements of the Mission System (or lower level equivalent), significantly degrading the system's ability to perform primary mission (decision support).	Occasional	Moderate	B3	Improbable	Moderate	B2
24	Security of data	There is a chance that imagery/data transmitted from the UAS can be intercepted, resulting in a security breach or possible compromise of operations	(1) Hostile intercept (2) Inadequate security controls on data (3) Inappropriate usage of Micro-UAS	Would cause damage, security incident possibly involving compromise, loss or unauthorised disclosure of classified or sensitive information, equipment, strategy or tactics that affects capability and functionality.	Probable	Moderate	B4	Improbable	Moderate	B2
25	Spectrum usage	There is a chance that the UAS will inappropriately use the wrong frequency, causing interference with other agencies	(1) Inadequate design of system (2) Inadequate control of spectrum by SPO / Defence	Damage to reputation at Executive level.	Improbable	Moderate	B2	Rare	Moderate	B1
26	Theft / hijacking	There is a chance that the UAS can be stolen or hijacked and inappropriately operated	(1) Inadequate design of system (2) Hostile action (3) Lack of security measures	Would cause damage, security incident possibly involving compromise, loss or unauthorised disclosure of classified or sensitive information, equipment, strategy or tactics that affects capability and functionality, or damage to reputation at Executive level.	Improbable	Moderate	B2	Rare	Moderate	B1
27	Not fit for service	There is a chance that the UAS is unable to meet its operational requirement set.	(1) Inadequate requirements definition (2) Inadequate Validation	Inability to achieve any missions. This may have serious unit / tactical implications, or represent a waste of the procurement spend	Occasional	Major	C3	Rare	Major	C1

20 threats identified.

Pre-mitigation max risk level: High (x4)

Post mitigation max risk level: Low (x2)

Increased weight & speed from Micro-UAS increases consequence of impact with people / buildings / aircraft

Small UAS Risk Assessment Outcomes

ID	Title	Description	Causes	Consequences	Likelihood	Consequence	Original Risk Level	Residual Likelihood	Residual Consequence	Residual Risk Level
1	Mechanical injury	There is a chance that personnel in the area of operations of the Small UAS could suffer a mechanical injury from the air vehicle or launch / recovery system	(1) Physical contact with the rotor blades / propeller (2) Debris thrown by UA (3) Physical contact with launch / recovery system	Could result in permanent partial disability (e.g. hand injury, blindness in one eye, disfigurement).	Probable	Major	C4	Improbable	Major	C2
2	Impact injury	There is a chance that personnel in the area of operations of the Small UAS could be injured or killed by a physical impact with the air vehicle or operating launch/recovery systems.	(1) Physical impact with Small UAS (2) Physical contact with launch / recovery system	Serious injury or death	Probable	Critical	D4	Rare	Critical	D1
3	Ergonomic injury	There is a chance that personnel operating the UA or receiving data could sustain long term injuries due to poor posture whilst operating the UAS Ground Control Station or Remote Viewing Terminal	(1) Poor posture whilst operating the Ground Control Station or the Remote Viewing Terminal (2) Inadequate design of controller	Could result in permanent partial disability (e.g. back injury)	Almost Certain	Major	C5	Occasional	Moderate	B3
4	Lifting injury	There is a chance that personnel moving the UA or launch / recovery system could sustain long term injuries due to poor handling techniques	(1) Poor handling techniques	Could result in permanent partial disability (e.g. back injury)	Probable	Major	C4	Improbable	Major	C2
5	Vertigo/dizziness	There is a chance that personnel operating the UA or receiving data could sustain vertigo or dizziness due to conflicts between the received video & ground motion	(1) Inadequate design of controller (2) Inadequate training (3) Individual characteristics (some people are more susceptible, especially when ill)	(1) There could be minor injuries that are treated at the site with no long-term effects. (2) There could be a temporary loss of mission capability whilst the operator is ill.	Probable	Minor	A4	Rare	Minor	A1
6	Electrical injury	There is a chance that personnel operating or maintaining the UAV could be exposed to the risk of electrical shock or thermal burn, resulting in injury.	(1) Inadequate design of air vehicle or system components (2) Operating the unit whilst defective	At the DC voltages normally seen in small electrical items, could result in first aid or minor supportive medical treatment. Auxiliary equipment, such as chargers, operate on 240V AC and a malfunction may cause electrocution, leading to death.	Occasional	Critical	D3	Rare	Major	C1
7	Radiation injury	There is a chance that personnel operating or maintaining the UAV could be exposed to a radiation hazard, resulting in injury.	(1) Inadequate design of air vehicle or system components (2) Operating the unit whilst defective	Could result in temporary partial disability less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation.	Improbable	Moderate	B2	Rare	Moderate	B1
8	Noise injury	There is a chance that personnel operating or maintaining the UA could be exposed to excessive noise, leading to a hearing injury	(1) Inadequate design of air vehicle or system components (2) Operating the unit whilst defective	This is possible, particularly with combustion engines. It could result in permanent hearing damage (permanent disability) which may be eligible for compensation.	Probable	Major	C4	Rare	Major	C1
9	Thermal injury	There is a chance that personnel operating or maintaining the UA could be exposed to excessive heat or cold, leading to a thermal injury	(1) High surface temperatures from batteries, engines or avionics (2) High temperatures from cooling fluids (3) Very low surface temperatures from cooling systems	Could result in temporary partial disability (burns) less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation.	Occasional	Moderate	B3	Improbable	Moderate	B2
10	Explosive injury	There is a chance that personnel operating or maintaining the UA could be injured by the accidental detonation of explosive devices used on the air vehicle	(1) Accidental detonation of explosive squibs	Could result in permanent partial disability (e.g. hand injury, blindness in one eye, disfigurement)	Occasional	Major	C3	Rare	Moderate	B1
11	Chemical injury	There is a chance that personnel operating or maintaining the UA could be exposed to chemicals contained within the UAS or carried on the air vehicle, causing injury.	(1) Exposure to fuels (2) Exposure to chemicals carried as part of the payload (e.g. pest spray).	Ingestion of hazardous substances could result in temporary partial disability less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation, or short term damage to the environment which is rectifiable.	Occasional	Moderate	B3	Rare	Moderate	B1
12	Pressure injury	There is a chance that personnel operating or maintaining the UA or launch / recovery system could be exposed to high pressures, causing injury	(1) Failure of a pressure vehicle (e.g. hydrogen canister or pneumatic piston in launcher).	Could result in permanent partial disability (e.g. limb injury)	Improbable	Critical	D2	Rare	Critical	D1
13	Laser injury	There is a chance that personnel operating or maintaining the UA could be injured from the operation of lasers contained within the UAS	(1) Inadequate design of the laser system (2) Inappropriate operation	Worst case is permanent blindness in both eyes	Occasional	Critical	D3	Rare	Major	C1
14	Hazardous Substances	There is a chance that during into, damaging or burning the air vehicle or other system components may release hazardous substances, including carbon fibre, glass fibre, or fuel.	(1) Inadequate design of air vehicle or system components (2) Inappropriate maintenance (3) Incident involving damage, explosives or fire (4) Chemical spill	Ingestion of hazardous substances could result in temporary partial disability less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation, or short term damage to the environment which is rectifiable.	Occasional	Moderate	B3	Rare	Moderate	B1
15	Battery fire	There is a chance that the system batteries may spontaneously combust, causing a fire or releasing hazardous substances	(1) Inadequate design of air vehicle or system components (2) Operating the unit whilst defective (3) Operating, storage or transport of the battery outside design limitations (4) Inherent nature of chemical battery types	A fire on board an aircraft, ship or other major equipment type could result in total loss, including loss of life.	Occasional	Catastrophic	E3	Rare	Major	C1
16	Fuel fire	There is a chance that fuel contained within the UAS may ignite, causing an explosion or fire.	(1) Inadequate design of air vehicle or system components (2) Operating the unit whilst defective (3) Inadequate maintenance	A fuel fire could cause localised damage or injury, possibly even up to death, and possible complete destruction of the air vehicle.	Occasional	Critical	D3	Rare	Critical	D1
17	Starts bushfire	There is a chance that the operation or crash of an air vehicle may lead to a bush fire	(1) Spark from impact of air vehicle into solid object (2) Spark from electrical system (including battery) (3) Fuel ignition	Damage to reputation at DoD. Risk of fire damage to property Risk of injury or death caused by fire to personnel Associated legal liability	Rare	Catastrophic	E1	Rare	Catastrophic	E1
18	Disposal hazards	There is a chance that the UAS may cause an environmental hazard when disposed (which may include abandonment)	(1) Hazardous substances in propulsion system (battery or fuel) (2) Hazardous materials used in the construction of the system	Hazardous materials may cause environmental pollution, such as air pollution or water system pollution, if they leach out of the system components or are otherwise released into the environment	Occasional	Moderate	B3	Rare	Moderate	B1
19	Component failure	There is a chance that some component of the UAS becomes unserviceable, causing the aircraft to be unavailable for its mission	(1) Inadequate design of air vehicle or system components (2) Inappropriate maintenance (3) Incident involving damage, explosives or fire	Temporary loss of mission capability whilst unserviceable component is repaired, resulting in significant unit/tactical implications	Almost Certain	Moderate	B5	Improbable	Moderate	B2
20	Loss of air vehicle	There is a chance that a Small UAS air vehicle becomes lost, resulting in financial damage.	(1) Loss of control (2) Weather implications (3) Disorientation (4) Deliberate hostile action	Financial loss equal to the replacement cost of the asset (may be in the range \$100k - \$1M) Loss of capability until asset can be replaced. Exposure of personnel to more risk to gather required data whilst air vehicle is unavailable	Probable	Moderate	B4	Rare	Moderate	B1
21	Damage to other aircraft	There is a chance that a Small UAS air vehicle could cause damage to another aircraft, including by being injected into an engine, causing damage to that aircraft.	(1) In flight collision (2) Inadequate airspace awareness (3) Deliberate hostile action (4) Disorientation (5) Weather implications	Inability to achieve one or more of the significant requirements of the impacted aircraft, significantly degrading the system's ability to perform primary mission.	Occasional	Catastrophic	E3	Rare	Catastrophic	E1
22	Damage to buildings / property	There is a chance that a Small UAS could cause damage to buildings or property through impact or debris damage	(1) In flight collision (2) Inadequate airspace awareness (3) Deliberate hostile action (4) Disorientation (5) Weather implications	The damaged property or building is functionally fit for all desired missions or tasks, but there may be some qualification to the level to which it would perform non-critical elements of the mission or task. Likely cost to rectify damage \$100k to \$1M or repair time 2-14 working days	Probable	Moderate	B4	Rare	Moderate	B1
23	Inaccurate / incorrect data	There is a chance that data coming from the UAS (e.g. position information) is incorrect or inaccurate, leading to difficulties processing the data	(1) Poor design of payload (2) Poor design of aircraft systems (3) Poor design of datalink (4) Deliberate hostile action (cyber attack, jamming, spoofing).	Inability to achieve one or more of the significant requirements of the Mission System (or lower level equivalent), significantly degrading the system's ability to perform primary mission (decision support).	Occasional	Moderate	B3	Improbable	Moderate	B2
24	Security of data	There is a chance that imagery/data transmitted from the UAS can be intercepted, resulting in a security breach or possible compromise of operations	(1) Hostile intercept (2) Inadequate security controls on data	Would cause damage, security incident possibly involving compromise, loss or unauthorised disclosure of classified or sensitive information, equipment, strategy or tactics that affects capability and functionality	Probable	Moderate	B4	Improbable	Moderate	B2
25	Spectrum usage	There is a chance that the UAS will inappropriately use the wrong frequency, causing interference with other agencies	(1) Inadequate design of system (2) Inadequate control of spectrum by SPO / Defence	Damage to reputation at Executive level	Improbable	Moderate	B2	Rare	Moderate	B1
26	Theft / hijacking	There is a chance that the UAS can be stolen or hijacked and inappropriately operated	(1) Inadequate design of system (2) Hostile action (3) Lack of security measures	Would cause damage, security incident possibly involving compromise, loss or unauthorised disclosure of classified or sensitive information, equipment, strategy or tactics that affects capability and functionality. Short term national media attention.	Improbable	Major	C2	Rare	Major	C1
27	Not fit for service	There is a chance that the UAS is unable to meet its operational requirement set.	(1) Inadequate requirements definition (2) Inadequate Validation	Inability to achieve any missions. This may have serious unit / tactical implications, or represent a waste of the procurement spend	Occasional	Major	C3	Rare	Major	C1

27 threats identified.

Pre-mitigation max risk level: High (x10)

Post mitigation max risk level: Low (x8)

Use of fuel engines & carriage of payload increases range of risk. Some risks are more common vs V.Small UAS

Medium UAS Risk Assessment Outcomes

ID	Title	Description	Causes	Consequences	Likelihood	Consequence	Original Risk Level	Residual Likelihood	Residual Consequence	Residual Risk Level
1	Mechanical injury	There is a chance that personnel in the area of operations of the Medium UAS could suffer a mechanical injury from the air vehicle or launch / recovery system	(1) Physical contact with the rotor blades / propeller (2) Debris thrown by UA (3) Physical contact with launch / recovery system	Could result in permanent partial disability (e.g. hand injury, blindness in one eye, disfigurement).	Probable	Major	C4	Improbable	Major	C2
2	Impact injury	There is a chance that personnel in the area of operations of the Medium UAS could be injured or killed by a physical impact with the air vehicle or operating launch/recovery systems.	(1) Physical impact with Medium UA (2) Physical contact with launch / recovery system	Serious injury or death	Probable	Catastrophic	E4	Improbable	Catastrophic	E2
3	Ergonomic injury	There is a chance that personnel operating the UA or receiving data could sustain long term injuries due to poor posture whilst operating the UAS Ground Control Station or Remote Viewing Terminal	(1) Poor posture whilst operating the Ground Control Station or the Remote Viewing Terminal (2) Inadequate design of controller	Could result in permanent partial disability (e.g. back injury)	Almost Certain	Major	C5	Occasional	Moderate	B3
4	Lifting injury	There is a chance that personnel moving the UA or launch / recovery system could sustain long term injuries due to poor handling techniques	(1) Poor handling techniques	Could result in permanent partial disability (e.g. back injury)	Probable	Major	C4	Improbable	Major	C2
5	Vertigo/dizziness	There is a chance that personnel operating the UA or receiving data could sustain vertigo or dizziness due to conflicts between the received video & ground motion	(1) Inadequate design of controller (2) Inadequate training (3) Individual characteristics (some people are more susceptible, especially when ill)	(1) There could be minor injuries that are treated at the site with no long-term effects. (2) There could be a temporary loss of mission capability whilst the operator is ill.	Probable	Minor	A4	Rare	Minor	A1
6	Electrical injury	There is a chance that personnel operating or maintaining the UAV could be exposed to the risk of electrical shock or thermal burn, resulting in injury.	(1) Inadequate design of air vehicle, components or payloads (2) Operating the unit whilst defective	At the DC voltages normally seen in small electrical items, could result in first aid or minor supportive medical treatment. Ancillary equipment, such as chargers, operate on 240V AC and a malfunction may cause electrocution, leading to death.	Occasional	Critical	D3	Rare	Major	C1
7	Radiation injury	There is a chance that personnel operating or maintaining the UAV could be exposed to a radiation hazard, resulting in injury.	(1) Inadequate design of air vehicle, components or payloads (2) Operating the unit whilst defective	Could result in temporary partial disability less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation.	Occasional	Moderate	B3	Rare	Moderate	B1
8	Noise injury	There is a chance that personnel operating or maintaining the UA could be exposed to excessive noise, leading to a hearing injury	(1) Inadequate design of air vehicle, components or payloads (2) Operating the unit whilst defective	This is possible, particularly with combustion engines. It could result in permanent hearing damage (permanent disability) which may be eligible for compensation.	Probable	Major	C4	Rare	Major	C1
9	Thermal injury	There is a chance that personnel operating or maintaining the UA could be exposed to excessive heat or cold, leading to a thermal injury	(1) High surface temperatures from batteries, engines or avionics (2) High temperatures from cooling fluids (3) Very low surface temperatures from cooling systems	Could result in temporary partial disability (burns) less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation.	Probable	Moderate	B4	Improbable	Moderate	B2
10	Explosive injury	There is a chance that personnel operating or maintaining the UA could be injured by the accidental detonation of explosive devices used on the air vehicle	(1) Accidental detonation of explosive squibs	Could result in permanent partial disability (e.g. hand injury, blindness in one eye, disfigurement)	Occasional	Major	C3	Rare	Moderate	B1
11	Chemical injury	There is a chance that personnel operating or maintaining the UA could be exposed to chemicals contained within the UAS or carried on the air vehicle, causing injury.	(1) Exposure to fuel (2) Exposure to chemicals carried as part of the payload (e.g. pest spray).	Ingestion of hazardous substances could result in temporary partial disability less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation, or short term damage to the environment which is rectifiable.	Occasional	Moderate	B3	Rare	Moderate	B1
12	Pressure injury	There is a chance that personnel operating or maintaining the UA or launch recovery system could be exposed to high pressures, causing injury	(1) Failure of a pressure vehicle (e.g. hydrogen canister or pneumatic piston in launcher).	Could result in permanent partial disability (e.g. limb injury)	Improbable	Critical	D2	Rare	Critical	D1
13	Laser injury	There is a chance that personnel operating or maintaining the UA could be injured from the operation of lasers contained within the UAS.	(1) Inadequate design of the laser system (2) Inappropriate operation	Worst case is permanent blindness in both eyes	Occasional	Critical	D3	Rare	Major	C1
14	Hazardous Substances	There is a chance that spilling into, damaging or burning the air vehicle or other system components may release hazardous substances, including carbon fibre, glass fibre, or fuel.	(1) Inadequate design of air vehicle, components or payloads (2) Inappropriate maintenance (3) Incident involving damage, explosives or fire (4) Chemical spill	Ingestion of hazardous substances could result in temporary partial disability less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation, or short term damage to the environment which is rectifiable.	Probable	Moderate	B4	Rare	Moderate	B1
15	Battery fire	There is a chance that the system batteries may spontaneously combust, causing a fire or releasing hazardous substances	(1) Inadequate design of air vehicle, components or payloads (2) Operating the unit whilst defective (3) Operating, storage or transport of the battery outside design limitations (4) Inherent nature of chemical battery types	A fire on board an aircraft, ship or other major equipment type could result in total loss, including loss of life.	Occasional	Catastrophic	E3	Rare	Major	C1
16	Fuel fire	There is a chance that fuel contained within the UA may ignite, causing an explosion or fire.	(1) Inadequate design of air vehicle or system components (2) Operating the unit whilst defective (3) Inadequate maintenance	A fuel fire could cause localised damage or injury, possibly even up to death, and possible complete destruction of the air vehicle.	Occasional	Critical	D3	Rare	Critical	D1
17	Starts bushfire	There is a chance that the operation or crash of an air vehicle may lead to a bush fire	(1) Spark from impact of air vehicle into solid object (2) Spark from electrical system (including battery) (3) Fuel ignition	Damage to reputation at DoD & associated legal liability Risk of fire damage to property Risk of injury or death caused by fire to personnel Financial loss equal to the replacement cost of the asset and payloads (may be in the range \$1M - \$10M) Loss of capability until asset can be replaced.	Occasional	Catastrophic	E3	Rare	Catastrophic	E1
18	Disposal hazards	There is a chance that the UAS may cause an environmental hazard when disposed (which may include abandonment)	(1) Hazardous substances in propulsion system (battery or fuel) (2) Hazardous materials used in the construction of the system	Hazardous materials may cause environmental pollution, such as air pollution or water system pollution, if they leach out of the system components or are otherwise released into the environment	Probable	Moderate	B4	Rare	Moderate	B1
19	Component failure	There is a chance that some component of the UAS becomes unseizable, causing the aircraft to be unavailable for its mission	(1) Inadequate design of air vehicle or system components (2) Inappropriate maintenance (3) Incident involving damage, explosives or fire	Temporary loss of mission capability whilst unseizable component is repaired, resulting in significant unit/tactical implications	Almost Certain	Major	C5	Probable	Minor	A4
20	Loss of air vehicle	There is a chance that a Medium UAS air vehicle becomes lost, resulting in financial damage.	(1) Loss of control (2) Weather implications (3) Disorientation (4) Deliberate hostile action	Financial loss equal to the replacement cost of the asset and payloads (may be in the range \$1M - \$10M) Loss of capability until asset can be replaced. Exposure of personnel to more risk to gather required data whilst air vehicle is unavailable	Almost Certain	Major	C5	Improbable	Major	C2
21	Damage to other aircraft	There is a chance that a Medium UAS air vehicle could cause damage to another aircraft through an in-flight collision	(1) In-flight collision (2) Inadequate airspace awareness (3) Deliberate hostile action (4) Disorientation (5) Weather implications	The impacted aircraft is destroyed, with complete loss of life.	Probable	Catastrophic	E4	Improbable	Catastrophic	E2
22	Damage to buildings / property	There is a chance that a Medium UAS could cause damage to buildings or property through impact or debris damage	(1) In-flight collision (2) Inadequate airspace awareness (3) Deliberate hostile action (4) Disorientation (5) Weather implications	The damaged property or building is destroyed.	Probable	Critical	D4	Improbable	Critical	D2
23	Inaccurate / incorrect data	There is a chance that data coming from the UAS (e.g. position information) is incorrect or inaccurate, leading to difficulties processing the data	(1) Poor design of payload (2) Poor design of aircraft systems (3) Poor design of data link (4) Deliberate hostile action (cyber attack, jamming, spoofing)	Inability to achieve one or more of the significant requirements of the Mission System (or lower level equivalent), significantly degrading the system's ability to perform primary mission (decision support).	Occasional	Major	C3	Improbable	Major	C2
24	Security of data	There is a chance that imagery/data transmitted from the UAS can be intercepted, resulting in a security breach or possible compromise of operations	(1) Hostile intercept (2) Inadequate security controls on data	Would cause damage, security incident possibly involving compromise, loss or unauthorised disclosure of classified or sensitive information, equipment, strategy or tactics that affects capability and functionality	Probable	Major	C4	Improbable	Major	C2
25	Spectrum usage	There is a chance that the UAS will inappropriately use the wrong frequency, causing interference with other agencies	(1) Inadequate design of system (2) Inadequate control of spectrum by SPO / Defence (3) On aircraft interference between different systems & payloads	Inability to achieve a subset of missions. This may have serious unit / tactical implications, or represent a waste of the procurement spend for the payload.	Probable	Major	C4	Improbable	Major	C2
26	Theft / hijacking	There is a chance that the UAS can be stolen or hijacked and inappropriately operated	(1) Inadequate design of system (2) Hostile action (3) Lack of security measures	Would cause damage, security incident possibly involving compromise, loss or unauthorised disclosure of classified or sensitive information, equipment, strategy or tactics that affects capability and functionality. Short term national media attention.	Occasional	Major	C3	Improbable	Major	C2
27	Not fit for service	There is a chance that the UAS is unable to meet its operational requirement set.	(1) Inadequate requirements definition (2) Inadequate Validation	Inability to achieve any missions. This may have serious unit / tactical implications, or represent a waste of the procurement spend	Occasional	Critical	D3	Rare	Critical	D1

27 threats identified.

Pre-mitigation max risk level: Very High (x2)

Post mitigation max risk level: Medium (x3)

Greater size & weight increases likelihood & consequences of accident, vs. Small UAS.

Large UAS Risk Assessment Outcomes

ID	Title	Description	Causes	Consequences	Likelihood	Consequence	Original Risk Level	Residual Likelihood	Residual Consequence	Residual Risk Level
1	Mechanical injury	There is a chance that personnel in the area of operations of the Large UAS could suffer a mechanical injury from the air vehicle or launch / recovery system	(1) Physical contact with the rotor blades / propeller (2) Debris thrown by UA (3) Physical contact with launch / recovery system	Could result in severe injury or death.	Probable	Critical	D4	Improbable	Critical	D2
2	Impact injury	There is a chance that personnel in the area of operations of the Large UAS could be injured or killed by a physical impact with the air vehicle or operating launch/recovery systems.	(1) Physical impact with Large UA (2) Physical contact with launch / recovery system	Serious injury or death	Probable	Catastrophic	E4	Improbable	Catastrophic	E2
3	Ergonomic injury	There is a chance that personnel operating the UA or receiving data could sustain long term injuries due to poor posture whilst operating the UAS Ground Control Station or Remote Viewing Terminal	(1) Poor posture whilst operating the Ground Control Station or the Remote Viewing Terminal (2) Inadequate design of controller	Could result in permanent partial disability (e.g. back injury)	Almost Certain	Major	C5	Occasional	Moderate	B3
4	Lifting injury	There is a chance that personnel moving the UA or launch / recovery system could sustain long term injuries due to poor handling techniques	(1) Poor handling techniques	Could result in permanent partial disability (e.g. back injury)	Almost Certain	Major	C5	Occasional	Major	C3
5	Vestibulodizziness	There is a chance that personnel operating the UA or receiving data could sustain vertigo or dizziness due to conflicts between the received video & ground motion	(1) Inadequate design of controller (2) Inadequate training (3) Individual characteristics (some people are more susceptible especially when ill)	(1) There could be minor injuries that are treated at the site with no long-term effects. (2) There could be a temporary loss of mission capability whilst the operator is ill.	Probable	Minor	A4	Rare	Minor	A4
6	Electrical injury	There is a chance that personnel operating or maintaining the UAV could be exposed to the risk of electrical shock or thermal burn, resulting in injury.	(1) Inadequate design of air vehicle, components or payloads (2) Operating the unit whilst defective	At the DC voltages normally seen in small electrical items, could result in first aid or minor supportive medical treatment. Ancillary equipment, such as chargers, operate on 240V AC and a malfunction may cause electrocution, leading to death.	Occasional	Critical	D3	Rare	Major	C1
7	Radiation injury	There is a chance that personnel operating or maintaining the UAV could be exposed to a radiation hazard, resulting in injury.	(1) Inadequate design of air vehicle, components or payloads (2) Operating the unit whilst defective	Could result in temporary partial disability less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation.	Probable	Moderate	B4	Rare	Moderate	B1
8	Noise injury	There is a chance that personnel operating or maintaining the UA could be exposed to excessive noise, leading to a hearing injury	(1) Inadequate design of air vehicle, components or payloads (2) Operating the unit whilst defective	This is possible, particularly with combustion engines. It could result in permanent hearing damage (permanent disability) which may be eligible for compensation.	Probable	Major	C4	Rare	Major	C1
9	Thermal injury	There is a chance that personnel operating or maintaining the UA could be exposed to excessive heat or cold, leading to a thermal injury	(1) High surface temperatures from batteries, engines or avionics (2) High temperatures from cooling fluids (3) Very low surface temperatures from cooling systems	Could result in temporary partial disability (burns) less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation.	Probable	Moderate	B4	Improbable	Moderate	B2
10	Explosive injury	There is a chance that personnel operating or maintaining the UA could be injured by the accidental detonation of explosive devices used on the air vehicle	(1) Accidental detonation of explosive squibs	Could result in permanent partial disability (e.g. hand injury, blindness in one eye, disfigurement)	Occasional	Major	C3	Rare	Moderate	B1
11	Chemical injury	There is a chance that personnel operating or maintaining the UA could be exposed to chemicals contained within the UAS or carried on the air vehicle, causing injury.	(1) Exposure to fuel (2) Exposure to chemicals carried as part of the payload (e.g. pest spray).	Ingestion of hazardous substances could result in temporary partial disability less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation, or short term damage to the environment which is rectifiable.	Probable	Moderate	B4	Rare	Moderate	B1
12	Pressure injury	There is a chance that personnel operating or maintaining the UA or launch / recovery system could be exposed to high pressures, causing injury	(1) Failure of a pressure vehicle (e.g. hydrogen canister or pneumatic piston in launcher).	Could result in permanent partial disability (e.g. limb injury) or death	Occasional	Critical	D3	Rare	Critical	D1
13	Laser injury	There is a chance that personnel operating or maintaining the UA could be injured from the operation of lasers contained within the UAS.	(1) Inadequate design of the laser system (2) Inappropriate operation	Worst case is permanent blindness in both eyes	Probable	Critical	D4	Rare	Major	C1
14	Hazardous Substances	There is a chance that drilling into, damaging or burning the air vehicle or other system components may release hazardous substances, including carbon fibre, glass fibre, or fuel.	(1) Inadequate design of air vehicle, components or payloads (2) Inappropriate maintenance (3) Incident involving damage, explosives or fire (4) Chemical spill	Ingestion of hazardous substances could result in temporary partial disability less than 30 days, hospitalisation, emergency medical treatment, injury or illness eligible for compensation, or short term damage to the environment which is rectifiable.	Almost Certain	Moderate	B5	Rare	Moderate	B1
15	Battery fire	There is a chance that the system batteries may spontaneously combust, causing a fire or releasing hazardous substances	(1) Inadequate design of air vehicle, components or payloads (2) Operating the unit whilst defective (3) On Operating, storage or transport of the battery outside design limitations (4) Inherent nature of chemical battery types	A fire on board an aircraft, ship or other major equipment type could result in total loss, including loss of life.	Occasional	Catastrophic	E3	Rare	Major	C1
16	Fuel fire	There is a chance that fuel contained within the UA may ignite, causing an explosion or fire.	(1) Inadequate design of air vehicle or system components (2) Operating the unit whilst defective (3) Inadequate maintenance	A fuel fire could cause localised damage or injury, possibly even up to death, and possible complete destruction of the air vehicle.	Occasional	Critical	D3	Rare	Critical	D1
17	Starts bushfire	There is a chance that the operation or crash of an air vehicle may lead to a bush fire	(1) Spark from impact of air vehicle into solid object (2) Spark from electrical system (including battery) (3) Fuel ignition	Damage to reputation at DoD & associated legal liability Risk of fire damage to property Risk of injury or death caused by fire to personnel Financial loss equal to the replacement cost of the asset and payloads (may be in the range \$1M - \$10M) Loss of capability until asset can be replaced.	Occasional	Catastrophic	E3	Rare	Catastrophic	E1
18	Disposal hazards	There is a chance that the UAS may cause an environmental hazard when disposed (which may include abandonment)	(1) Hazardous substances in propulsion system (battery or fuel) (2) Hazardous materials used in the construction of the system	Hazardous materials may cause environmental pollution, such as air pollution or water system pollution, if they leach out of the system components or are otherwise released into the environment	Probable	Moderate	B4	Rare	Moderate	B1
19	Component failure	There is a chance that some component of the UAS becomes unserviceable, causing the aircraft to be unavailable for its mission	(1) Inadequate design of air vehicle or system components (2) Inappropriate maintenance (3) Incident involving damage, explosives or fire	Temporary loss of mission capability whilst unserviceable component is repaired, resulting in significant un/tactical implications	Almost Certain	Critical	D5	Probable	Moderate	B4
20	Loss of air vehicle	There is a chance that a Large UAS air vehicle becomes lost, resulting in financial damage.	(1) Loss of control (2) Weather implications (3) Disorientation (4) Deliberate hostile action	Financial loss equal to the replacement cost of the asset and payloads (may be in the range \$10M - \$100M) Loss of capability until asset can be replaced. Exposure of personnel to more risk to gather required data whilst air vehicle is unavailable.	Almost Certain	Critical	D5	Improbable	Critical	D4
21	Damage to other aircraft	There is a chance that a Large UAS air vehicle could cause damage to another aircraft through an in-flight collision	(1) In flight collision (2) Inadequate airspace awareness (3) Deliberate hostile action (4) Disorientation (5) Weather implications	The impacted aircraft is destroyed, with complete loss of life.	Probable	Catastrophic	E4	Improbable	Catastrophic	E2
22	Damage to buildings / property	There is a chance that a Large UAS could cause damage to buildings or property through impact or debris damage	(1) In flight collision (2) Inadequate airspace awareness (3) Deliberate hostile action (4) Disorientation (5) Weather implications	The damaged property or building is destroyed.	Probable	Critical	D4	Improbable	Critical	D2
23	Inaccurate / incorrect data	There is a chance that data coming from the UAS (e.g. position information) is incorrect or inaccurate, leading to difficulties processing the data	(1) Poor design of payload (2) Poor design of spectrum by SPO / Defence (3) Poor design of datalink (4) Deliberate hostile action (cyber attack, jamming, spoofing).	Inability to achieve one or more of the significant requirements of the Mission System (or lower level equivalent), significantly degrading the system's ability to perform primary mission (decision support).	Occasional	Major	C3	Improbable	Major	C2
24	Security of data	There is a chance that imagery/data transmitted from the UAS can be intercepted, resulting in a security breach or possible compromise of operations	(1) Hostile intercept (2) Inadequate security controls on data	Would cause damage, security incident possibly involving compromise, loss or unauthorised disclosure of classified or sensitive information, equipment, strategy or tactics that affects capability and functionality.	Probable	Major	C4	Improbable	Major	C2
25	Spectrum usage	There is a chance that the UAS will inappropriately use the wrong frequency, causing interference with other agencies	(1) Inadequate design of system (2) Inadequate control of spectrum by SPO / Defence (3) On aircraft interference between different systems & payloads	Inability to achieve a subset of missions. This may have serious unit / tactical implications, or represent a waste of the procurement spend for the payload.	Probable	Major	C4	Improbable	Major	C2
26	Theft / hijacking	There is a chance that the UAS can be stolen or hijacked and inappropriately operated	(1) Inadequate design of system (2) Hostile action (3) Lack of security measures	Would cause damage, security incident possibly involving compromise, loss or unauthorised disclosure of classified or sensitive information, equipment, strategy or tactics that affects capability and functionality. Short term national media attention.	Occasional	Major	C3	Improbable	Major	C2
27	Not fit for service	There is a chance that the UAS is unable to meet its operational requirement set.	(1) Inadequate requirements definition (2) Inadequate Validation	Inability to achieve any missions. This may have serious unit / tactical implications, or represent a waste of the procurement spend	Occasional	Critical	D3	Rare	Critical	D1

27 threats identified.

Pre-mitigation max risk level: Very High (x4)

Post mitigation max risk level: Medium (x7)

Main difference to Medium UAS due cost & size. Certification assists flight over civil airspace.



Australian Government

Department of Defence
Capability Acquisition and
Sustainment Group

Questions?





Backup

DASR.UAS Operational Summary

			Specific B					Specific A	Certified
	MTOW (kg)		SS: Micro UAS	SS: V. Small	SS: Defence Ranges & Ex. Areas	SS: High Seas	SS: Experiment & trials		
Micro UAS	0.1	CASA "Excluded"	* VLOS * <400 ft * VMC * Risk based controls for: - BVLOS - >400 ft - Non VMC						
Very Small UAS	2		* VLOS * <400 ft * VMC * >30m of GP * No Populous areas * >3nm or aerodrome * One pilot per vehicle		* <400ft without approval * One pilot per vehicle * Risk based controls for: - BVLOS - >400 ft - Non VMC - <30m of GP - Over populous areas & critical infrast. - <3nm of aerodrome			>1 pilot per vehicle?	
Small UAS	25	CASA Approval Required	* VLOS * <400 ft * VMC * >30m of GP * No Populous areas * >3nm or aerodrome * One pilot per vehicle * Defence land only * Nil controlled airspace w/out approval		* Only in active Restricted airspace * Only over Defence controlled land/water * One pilot per vehicle * Risk based controls for: - BVLOS - >400 ft - Non VMC - Over populous areas, MEP, vessels & critical infrast.	* >12nm of inhabited land * <400ft without approval * One pilot per vehicle * Risk based controls for: - BVLOS - >400 ft - Non VMC - Over MEP, vessels & critical infrast.	* Only in active Restricted airspace * Only over Defence controlled land/water * Risk based controls for: - BVLOS - >400 ft - Non VMC - Over MEP & critical infrast. - >1 air vehicle per pilot	* Defence Registered * Have SOIU * Comply with DASR to the extent directed by the authority * Requirements and limitations as per UASOP Required for: - Small UAS on non-Defence land. - Medium UAS on non-Defence land - Medium UAS on Defence land in non-Restricted airspace - Large UAS which are not certifiable - Operation with >1 AV per pilot - Carriage of passengers - Carriage of weapons	* Defence Registered * Have SOIU * Type Certified (DASR 21 / AAP 7001.054) * Initial & Continuing Airworthiness DASR * Operated under MAOC * Qualified pilot Equivalent standards of safety to manned aircraft Note no current UAS FSTD standard.
Medium UAS	150		Requires CASA RePL if operating other than for sport or recreation						
Large UAS	>150	Certification Required							

DASR.UAS Technical Summary

			Open	Specific B				Specific A	Certified
	MTOW (kg)			SS: Micro UAS	SS: V. Small	SS: Defence Ranges & Ex. Areas	SS: High Seas		
Micro UAS	0.1	CASA "Excluded"	Nil	a. trigger autonomous flight actions upon loss of datalink b. positively contain the UA within a pre-programmed volume c. enable the RP to locate and avoid GP/MEP d. enable manual termination of flight by the RP during emergencies.					
Very Small UAS	2			(1) trigger autonomous flight actions upon loss of datalink (2) positively contain the UA within a pre-programmed volume (3) enable the RP to locate and avoid GP/MEP (4) enable manual termination of flight by the RP during emergencies					
Small UAS	25	CASA Approval Required			(1) trigger autonomous flight actions upon loss of datalink (2) positively contain the UA within a pre-programmed volume (3) enable the RP to locate and avoid GP/MEP (4) enable manual termination of flight by the RP during emergencies (5) display remaining battery/fuel level to the RP at all times	(1) trigger autonomous flight actions upon loss of datalink (2) positively contain the UA within a pre-programmed volume (3) enable the RP to locate and avoid GP/MEP (4) enable manual termination of flight by the RP during emergencies (5) display remaining battery/fuel level to the RP at all times	a. trigger autonomous flight actions upon loss of datalink (eg Autonomous Recovery System (ARS), Go-Home mode) b. positively contain the UA within a pre-programmed volume (eg geo-fencing, tether, range limiter, programmable maximum and minimum altitude) c. enable manual termination of flight by the RP during emergencies. Note: Depending on the nature of the trial and the unique risks it presents, the need for additional technical risk controls (eg a fully independent flight termination system) should be critically assessed.	Design mitigation. Design mitigation concerns the application of rigour to the design and construction process such that system's likelihood of catastrophic failure is known and controlled. Through the application of more rigorous design standards, or inclusion of systems designed to support safe operation, the likelihood of failure can be reduced. Systemic mitigation. Systemic mitigation concerns the application of regulatory standards to organisations involved in the design, construction, maintenance and operation of the system. Systemic mitigation is intended to reduce the occurrence of organisational and human errors which can contribute to failure of a system. Systemic mitigation supports design mitigation, operational mitigation, and continuing airworthiness of the system.	Full DASR is applicable: - DASR 211 / AAP 7001.054 - DASR M - DASR 145 Treat like manned aircraft
Medium UAS	150				(6) assist other aircraft to visually see the UA, where tactical constraints permit b. inspection, maintenance and testing that could prevent technical failures of the UAS, carried out at regular intervals in accordance with documented OEM or locally produced procedures (eg maximum airframe/propeller hours, battery servicing/replacement)	(6) assist other aircraft to visually see the UA, where tactical constraints permit b. inspection, maintenance and testing that could prevent technical failures of the UAS, carried out at regular intervals in accordance with documented OEM or locally produced procedures (eg maximum airframe/propeller hours, battery servicing/replacement)			
Large UAS	>150		Certification Required						

- DASR.UAS released Dec 17
- New categories:
 - Open
 - Specific Type B (Standard Scenarios)
 - Micro UAS
 - Very Small UAS
 - Defence Ranges & Exercise Areas
 - High Seas
 - Trials & Experimentation
 - Specific Type A (UASOP)
 - Certified
- Only 'Certified' and 'Specific Type A' (to the extent specified by the authority) call out remaining DASR regs – others have no DASR coverage.

- Work Health and Safety Act, 2011
- Requirement:
 - (a) to eliminate risks to health and safety, so far as is reasonably practicable; and*
 - (b) if it is not reasonably practicable to eliminate risks to health and safety, to minimise those risks so far as is reasonably practicable.*
- “Reasonably Practicable” takes in to account:
 - (a) the likelihood of the hazard or the risk concerned occurring; and
 - (b) the degree of harm that might result from the hazard or the risk; and
 - (c) what the person concerned knows or should know about the risk;
 - (d) the availability and suitability of ways to eliminate or minimise the risk; and
 - (e) after assessing the extent of the risk and the available ways of eliminating or minimising the risk, the cost associated with available ways of eliminating or minimising the risk, including whether the cost is grossly disproportionate to the risk

Kinetic Energy Graph

