



# **Airborne Delivery Challenge**

## **Mission, rules and judging criteria**

**Version: 1.0**

**Date: 1 April 2011**



**Queensland Government**

## **IMPORTANT NOTICE TO COMPETITORS**

**This document is subject to change by the Challenge organisers. The current rules document will be available from the challenge website. Registered participants will be notified of any changes.**

## Table of Contents

|   |    |
|---|----|
| Major Revision Record .....                                   | 4  |
| 1 The UAV Outback Challenge .....                             | 5  |
| 2 The Airborne Delivery Challenge .....                       | 5  |
| 2.1 The Mission .....   | 5  |
| 2.2 Conduct of the UAV Controller .....                       | 7  |
| 2.3 UAV Controller Equipment .....                            | 7  |
| 2.4 Normal Drop Procedures .....                              | 7  |
| 2.5 Drop Triggering .....                                     | 8  |
| 2.5.1 Remote Controlled Drop Triggering .....                 | 8  |
| 2.5.2 Autonomous Drop Triggering .....                        | 8  |
| 2.5.3 Changing drop method .....                              | 8  |
| 2.5.4 Measuring Joe's Location .....                          | 9  |
| 2.6 Scoring Criteria for Flying Component of Assessment ..... | 9  |
| 2.7 Adverse Weather .....                                     | 9  |
| 2.8 Additional Deliverables .....                             | 9  |
| 2.9 The Prizes .....  | 10 |
| 3 Challenge Safety .....                                      | 10 |
| 4 Schedule .....  | 11 |
| 5 Additional Rules .....                                      | 12 |
| 5.1 Aircraft Requirements and Limitations .....               | 12 |
| 5.2 Piloting Proficiency .....                                | 12 |
| 5.3 Safety Inspections .....                                  | 13 |
| 5.4 Flight Demonstration .....                                | 13 |
| 5.5 Practice Drop .....                                       | 13 |
| 5.6 Flight Termination Behaviour .....                        | 13 |
| 5.6.1 Alternate Flight Termination Systems .....              | 14 |
| 5.7 Take-off and landing .....                                | 14 |
| 5.8 Criteria for Flight Termination .....                     | 14 |
| 5.9 Team Sponsors .....                                       | 14 |
| 5.10 Liability and Insurance .....                            | 14 |
| 5.11 Loss of UAV Controller .....                             | 14 |
| 5.12 Sharing of Equipment between Teams .....                 | 15 |
| 5.13 Modifications After Technical Report Submission .....    | 15 |
| 5.14 Spectrum Management .....                                | 15 |
| 5.14.1 The RF Football .....                                  | 16 |
| 5.14.2 Transmitter Pound .....                                | 16 |
| 5.14.3 Tinker Time .....                                      | 16 |
| 6 Judging .....   | 17 |
| 6.1 Technical Report and Video .....                          | 17 |
| 6.2 Oral Presentation .....                                   | 18 |
| 6.3 Mission Performance (Flying) .....                        | 18 |
| 6.4 Rule Infringements .....                                  | 19 |
| 7 Awarding of Prizes .....                                    | 20 |
| 8 Guidelines for Spectrum Compliance .....                    | 20 |
| 8.1 The ACMA, Spectral Planning and Licensing .....           | 20 |
| 8.2 Class Licensing and The Challenge .....                   | 21 |
| 8.3 Guidelines for Using Class Licences .....                 | 21 |
| 8.4 ISM Frequencies .....                                     | 22 |
| 8.5 FINAL NOTE TO COMPETITORS .....                           | 22 |
| 9 Originality .....   | 23 |
| 10 Disclaimer .....   | 23 |

## Major Revision Record

Changes from 2010 include but are not limited to:

- Robot delivery challenge removed
- Section 2.1: changed supply package dimensions
- Section 2.1: minor changes to figure 1
- Section 2.5: new section on Drop Triggering
- Section 2.6: changed scoring method for drops to be the total score from all 3 drops
- Section 2.6: bonus points for using autonomous drop
- Section 2.9: change prize value and additional prizes for 2<sup>nd</sup> and 3<sup>rd</sup>
- Section 4: setting of dates for 2011
- Section 5.3 from 2010 removed: Teams are free to choose the frequency of their radio equipment provided they comply with the ACMA regulations
- Section 5.5: new section on practice drop
- Section 5.6: simplified flight termination requirements
- Section 5.13: new section on modifications after report submission
- Section 5.14: new section on spectrum management
- Section 6: modified points scoring values
- Section 6.4: new section on rule infringements
- Section 9: new section on originality

## 1 The UAV Outback Challenge

The goal of the UAV Outback Challenge is to demonstrate the utility of Unmanned Airborne Vehicles (UAVs) for civilian applications. The competitors will be required to develop a UAV that could save lives by quickly and cost effectively delivering medical supplies to critically ill patients in the Australian Outback.

The Challenge rules have been designed to address safety and maintain an acceptable level of aviation rigour, while attempting to maintain a high level of "fair play", accessibility, and enjoyment. There is an expectation that teams will enter into the Challenge with a desire to compete within the spirit of the challenge and not to exploit loopholes for an unfair advantage. The organisers and judges reserve the right to take action against any team or individual that conducts themselves in a manner judged contrary to the intent and spirit of the Challenge.

The Challenge will provide valuable experience to student and private entrants, in the design, construction and operation of UAVs. This experience will help create a future generation of aerospace professionals - all focused on the fastest growing component of the international aerospace industry.

The event comprises of 2 flying categories. These are the:

- Airborne Delivery Challenge (open to Australian high school students),
- Search and Rescue Challenge (open to all)

## 2 The Airborne Delivery Challenge

This category is only open to Australian high school students.

### 2.1 The Mission

A supply package(s) will be provided to each team for delivery on the day of the competition. The supply package (a muesli bar) will have the following specifications:

1. Size of 100x40x20 (mm)
2. Homogeneous mass distribution
3. Weight of 55 grams

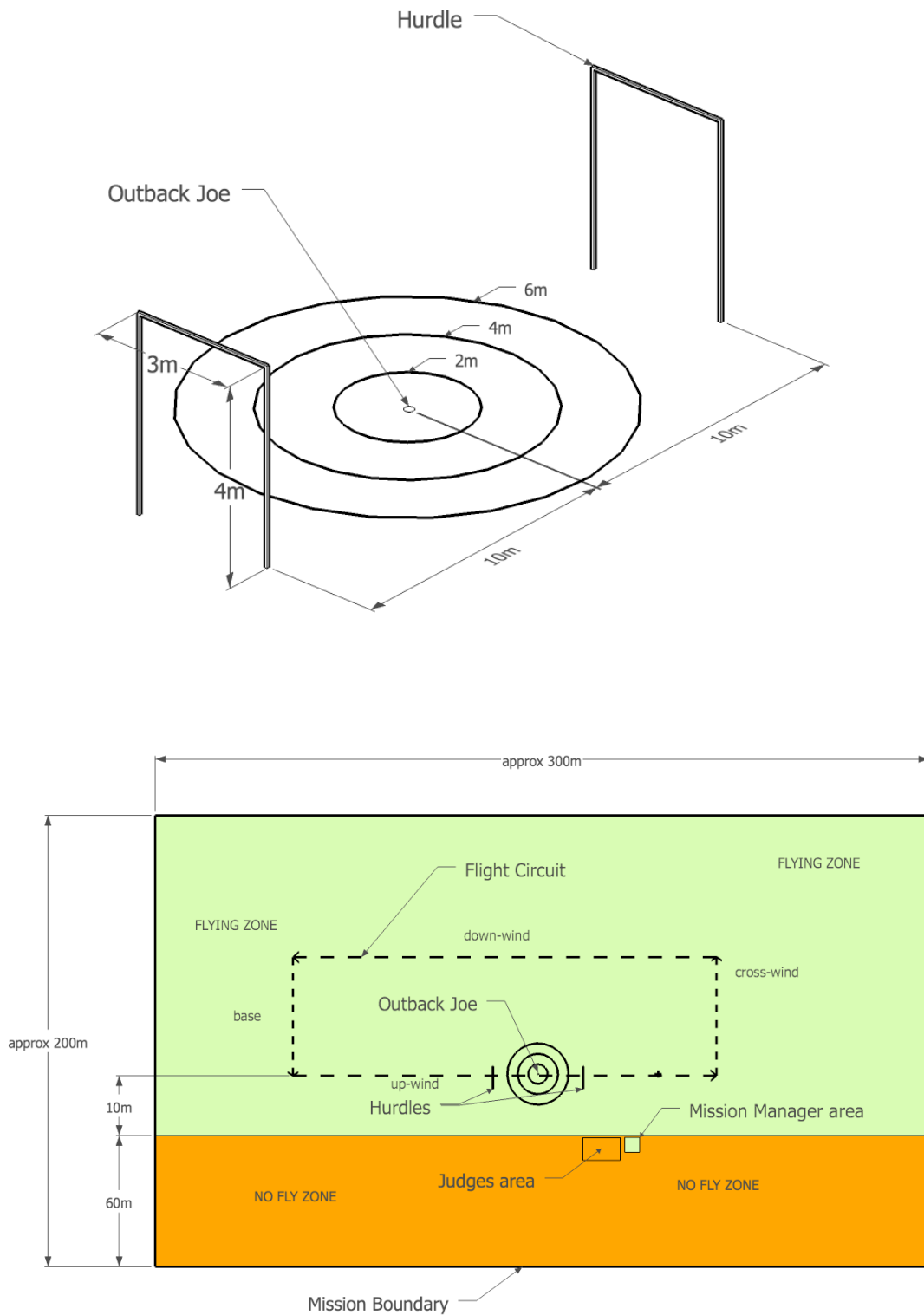
Each team must develop an airborne delivery system that can drop the provided supply package as close as possible to Outback Joe.

The aircraft will be remotely controlled by a human operator, known as the *UAV Controller*. The supply package will be triggered to drop in one of two ways:

1. Remotely by the *Mission Manager*
2. Autonomously by systems on board the aircraft.

The UAV Controller and the Mission Manager will act independently and without communication at any time the aircraft is airborne.

The layout for the course is shown in **Figure 1** below.



**Figure 1.** General Layout of the Airborne Delivery Challenge

## **2.2 Conduct of the UAV Controller**

The UAV Controller is responsible for launching and recovering the aircraft and the safe piloting of the aircraft once it is airborne. At all times the aircraft must be remotely controlled.

The UAV Controller must manoeuvre the aircraft such that it remains in the flying zone as shown in Figure 1. Spotters on the course will determine if the aircraft flies outside the flying zone.

Airspace incursion procedures:

- *Flying into the No-Fly Zone:* If the aircraft is deemed to have flown into the no-fly zone then the Range Safety Officer will direct the UAV Controller to land the aircraft without delay. The Range Safety Officer is responsible for the safe operations of the event. Upon landing the aircraft the team will be declared as disqualified due to safety reasons. The no-fly zone is designed to protect the general public who are watching the event.
- *Exiting the Flying Zone:* If the aircraft is deemed to have flown outside the flying zone (excluding the no-fly zone) then the Range Safety Officer will direct the UAV Controller to land the aircraft without delay. Upon landing the aircraft the Range Safety Officer will give a verbal warning to the UAV Controller. The clock will remain running throughout this process. The UAV Controller is allowed two warnings. If the flying zone is breached a third time, the Range Safety Officer will direct the UAV Controller to land the aircraft and to vacate the field. The team will then be declared as disqualified due to safety reasons.

The UAV Controller must adhere to the flight circuit procedures that will be provided at the competition.

## **2.3 UAV Controller Equipment**

Only radio transmitters that are compliant with Australian radio spectrum requirements may be used during the event. Fail safe must be set such that setting the transmitter off will initiate flight termination as described in section 5.6. Demonstration of this will be required prior to entering the competition.

## **2.4 Normal Drop Procedures**

Before the drop, the aircraft must fly down the upwind leg of the course and the aircraft must be manoeuvred such that it will pass directly overhead of the two hurdles that are laid out onto the course. The two hurdles have the following specifications:

1. Height of 4m
2. Width of 3 m
3. Open hurdles
4. Consist of 80mm x 80mm right angle aluminium

The UAV Controller must fly the aircraft such that it passes over the hurdles, but must not fly higher than 200 feet.

Each package delivery must occur within 3 circuits. The UAV Controller can perform as many additional circuits as desired before landing the aircraft, so long as it is within the time limit for the competition and the aircraft remains within the flying zone. The UAV Controller can launch and recover the aircraft as many times as desired within these constraints also. **The UAV Controller can move around the course as required in order to fly the aircraft in a safe manner.**

The aircraft must comply with the specifications in Section 5.1. Whilst flying between the hurdles, the aircraft must maintain an average minimum forward velocity of 3m/s. This will be verified by the judges.

## **2.5 Drop Triggering**

The objective is for the supply package to be deployed such that it comes to a rest as close as possible to Outback Joe. It is important to note that it is the final resting place of the package that will be used for judging criteria.

The dropping of the supply package can be triggered either by the mission manager or autonomously by systems on board the aircraft. Teams must select which drop triggering method they will use prior to the competition and include reference to their choice in the technical report and oral presentation.

### **2.5.1 Remote Controlled Drop Triggering**

The delivery of the supply package may be controlled by a human operator, known as the *Mission Manager*. The Mission Manager and associated equipment must be located within the mission manager's enclosure at all times during the mission. The Mission Manager's enclosure will be barricaded around the edges towards the flying area, covered from the top for safety and will be 2m x 2m or greater in area. The Mission Manager will NOT be able to see Outback Joe or the aircraft during the flying element of the competition and will NOT be able to communicate with the UAV Controller during the drop sequence.

The Mission Manager must control the delivery mechanism independently of the UAV Controller.

### **2.5.2 Autonomous Drop Triggering**

The delivery of the supply package may be triggered automatically by systems on board the aircraft. No interaction between the team members and the automatic triggering system is to occur while the aircraft is airborne. Other than via the power supply, there should be no electrical connection between the automatic dropping system and the remote control equipment.

### **2.5.3 Changing drop method**

In the event of technical difficulties, teams selecting automatic drop triggering can downgrade to manual drop triggering. This declaration must be when the team registers upon arrival at the event.

### **2.5.4 Measuring Joe's Location**

During their flight scrutineering or during their designated mission time, teams are permitted to measure Outback Joe's location.

A metal peg or pole will be driven into the ground and serve as the reference point for Outback Joe's location and the point from which distance measurements will be taken for scoring.

## **2.6 Scoring Criteria for Flying Component of Assessment**

Points will be awarded based on the proximity of the dropped supply packages to Outback Joe (Section 6.3). A maximum of three drops are allowed and each drop will be scored. **The combined total scores of all valid drops will be used for the final score.**

Teams who utilise autonomous drop triggering will be awarded a points bonus (section 6.3) provided at least a single drop lands within 10 metres of Outback Joe.

**A total allowable time of 20 minutes will be provided for each team in the Airborne Delivery Challenge.** This includes walking onto the field, set-up, launch, the mission, landing, recovery, pack-up and exiting the field. The judges will indicate when the timer starts and team can then enter the mission area.

**Teams must complete their mission and leave the field within the 20 minutes time period. A points penalty will be applied for time over the 20minutes.**

For full details on scoring refer to section 6.3.

## **2.7 Adverse Weather**

Postponement of the competition due to adverse weather conditions will be at the judges' discretion. Flying will be delayed if the 10-minute average wind speed exceeds 15kts. An adverse weather day has been built into the schedule (Section 4).

In the event that all teams do not have the opportunity to fly due to adverse weather the winners will be determined by the points from the team's technical report and oral presentation.

## **2.8 Additional Deliverables**

In addition to the points awarded for the mission, entrants will also be graded on a technical report and video (Section 6.1). The report will outline their design, methodology for package deployment and operational and safety procedures. An oral presentation must also be given at the competition (Section 6.2).

## **2.9 The Prizes**

The teams with the highest points totals as described in section 6 who flew at the competition and dropped at least one package within 10m of Outback Joe will be awarded the following prizes:

- |                 |         |
|-----------------|---------|
| 1. First Place  | \$8,000 |
| 2. Second Place | \$4,000 |
| 3. Third Place  | \$2,000 |

If teams are tied for a place the prize money for the positions they hold will be combined and shared equally between the teams. e.g. If two teams are tied for first place the prize money for first and second will be equally shared between those two teams.

## **3 Challenge Safety**

Safety is a priority for the UAV Outback Challenge, and the rules (Section 5) contained in the document have been put in place with safety in mind. The safety mechanisms that have been put in place include: ensuring compliance with CASR101 (where applicable); air vehicle safety inspections and structural verification; UAV Controller override capability; flight termination mode; and a proven history of safe flight operations.

Entrants are reminded that during their research and development phase, all test flying must comply with the relevant CASA regulations.

The rules outlined in Section 5 will be strictly enforced in order to reduce the risk associated with holding the UAV Outback Challenge. The organising committee may disqualify any entry that they deem to pose an unreasonable safety hazard to people and infrastructure.

## 4 Schedule

Table 2 below sets forth the competition schedule:

**Table 2.** 2011 Airborne Delivery Challenge schedule

| <b>Activity</b>   | <b>Date</b>                        |
|---|------------------------------------|
| <b>Registration</b><br><i>Registration details will be on the UAV Challenge website.</i>  | closes on 27 July 2011 at 5pm AEST |
| <b>Flight Readiness Review (Technical Report and Video)</b><br><i>A technical report (Section 6.1) must be provided. The underlying objective of this report is to convince the organising committee that the team has developed a reliable and safe UAV system, along with the appropriate operating procedures.</i><br><i>A video must also be supplied that includes a flight demonstration of the dropping mechanism that will deliver the payload.</i> | 24 Aug 2011 at 5pm AEST            |
| <b>Final team details required (pro-forma to organisers)</b><br><i>All participating teams must be approved to fly at the competition by CASA. Teams must supply the UAV Outback Challenge organisers with final team details. A form will be given to the teams to fill in.</i>  | 24 Aug 2011 at 5pm AEST            |
| <b>"Go" "No-Go" Announcement of Teams</b><br><i>Final approval to participate in the 2010 UAV Outback Challenge given to teams. The final approval to participate will be based on several aspects of the technical report, predominantly the demonstrated ability to operate within the competition safety standards.</i>  | 31 Aug 2011                        |
| <b>Team Insurance Deadline</b><br><i>Teams must provide documentation illustrating their insurance coverage. More details of insurance requirements and options will be posted on the UAV Challenge website. Teams that have not submitted this documentation by this date may be disqualified from the competition.</i>  | 7 Sep 2011                         |
| <b>High schools UAV Challenge</b><br><i>Orientation, Safety Briefing and Scrutineering, Oral Presentation.</i><br><b>Teams must arrive by 8 am.</b>   | 27 Sep 2011                        |
| <b>High schools UAV Challenge</b><br><i>Competition day</i>   | 28 Sep 2011                        |
| <b>Adverse Weather Day or Additional Competition Day (depending on number of teams)</b><br><i>A second competition day may be necessary depending on the number of teams.</i><br><i>An adverse weather day is allocated in case judges decide wind, rain or other adverse conditions interfere with the running of the competition.</i>   | 29 Sep 2011                        |

## 5 Additional Rules

### 5.1 Aircraft Requirements and Limitations

All aircraft entered will be subject to the following requirements and limitations:

1. Must use an electric propulsion system;
2. Must be free flying;
3. Have no entangling encumbrances such as tethers;
4. Takeoff gross weight must be less than 7 kg;
5. Must have continuous radio communication with the *UAV Controller*, and
6. Platform and onboard systems can be commercial off the shelf or custom made.

### 5.2 Piloting Proficiency

All Pilots will be required to demonstrate a competency in the following areas of airmanship, regardless if they hold an MAAA pilots rating for powered RC model aircraft. A scrutineering flight will take place with flight boundaries similar to a typical model aircraft field. Before qualifying to fly in the competition, each team pilot will be asked to perform the following routines and functions:

- Please note - **emphasis is on the pilot to demonstrate a high degree of control of his / her aircraft\***
- Demonstrate a take-off from a grass runway into a head or cross-wind, with safe transition into a rectangular circuit at a height of 200ft above ground level (AGL)
- Perform rectangular flight circuits in both clockwise and anti-clockwise directions, maintaining constant altitude in transacts and corners
- Minimal deviation (less than  $\pm 30$ ft) in altitude is desired
- Typical height for the demonstrated circuits will be 200ft AGL. Each circuit leg should be no less than 200ft in length
- Corners should be concise 90° angles and clearly demonstrated again with no loss or change in altitude
- Demonstrate a horizontal figure of 8, with large clearly defined circular parts of the '8', whilst maintaining constant altitude. The radius of the circle should be no less than 100ft and have clearly defined transitions from one half of the 8 to the other half
- Demonstrate a simulated landing circuit including; clearly defined crosswind, downwind and base legs, ending in a landing approach a landing into the wind\*\* and an aborted landing i.e. go around.

At any time, during any flights, the flight may be terminated by the organisers. In such an event, pilots should immediately follow the instructions given to them at that time, taking into account safety. Remember Aviate, Navigate then Communicate.

\*Pilots will be flying in front of crowds of spectators, including judges, marshals and event personnel. This can be an extremely nervous situation. It is highly recommended that pilots practice for such conditions.

\*\*No downwind landings will be permitted or requested, except in emergency situations.

### **5.3 Safety Inspections**

Prior to conducting any competition flights all aircraft and ground-based controlling equipment will undergo rigorous safety evaluations referred to as scrutineering. Static scrutineering will occur initially and these inspections must be passed before the aircraft will be permitted to fly. All decisions by the organising committee in relation to airworthiness are final.

Static safety inspections will include (but not be limited to) the following:

- Structural verification of the aircraft to ensure structural integrity including,
  - Components adequately secured and fasteners tightened
  - Propeller structure and attachment integrity
  - Inspection of all wiring
  - Controls move as expected
  - Payload general integrity
- Radio range checks with motor off and on;
- Flight termination behaviour tested (transmitter switched off);
- Aircraft will be weighed to ensure they fall within the weight restrictions;
- Video evidence and flight logs of flight tests demonstrating safe operations.
- Verifying that the aircraft being scrutineered matches the aircraft described in the submitted technical report

### **5.4 Flight Demonstration**

All teams will be required to conduct a scrutineering flight demonstrating (but not limited to) the following:

- the team's ability to safely launch the aircraft
- the UAV Controller's piloting competency (section 5.2)
- the aircraft's suitability for competition

These flights also provide teams with an opportunity to familiarise themselves with the flight area. The circuit to be flown will typically be the same as the mission circuit, but full details will be given to the teams at the time of their scrutineering flight.

### **5.5 Practice Drop**

If time permits, in conjunction with the scrutineering flights each team will be given the opportunity to conduct a single practice drop, including setup of their Mission Manager's equipment in the mission manager enclosure if performing remotely controlled drops.

### **5.6 Flight Termination Behaviour**

All teams must implement a safe flight termination behaviour for their aircraft. Specifically, teams must use radio receiver(s) that are capable of reverting to pre-defined failsafe values when radio communications are lost from the UAV Controller's radio transmitter. If for any reason the aircraft appears to be out of control during

the competition or during practice flights, the UAV Controller must turn off their transmitter, and invoke the flight termination mode.

The flight termination servo positions (programmed into the radio receiver) for fixed-wing aircraft and rotary-wing aircraft is to simply close the throttle.

In the case of lighter than air aircraft, strategies should be developed that ensure that the aircraft can be brought to ground in the case of failure, noting maximum crosswinds and the estimated maximum distances that the vehicle could exceed the mission boundary.

### **5.6.1 Alternate Flight Termination Systems**

If a team wishes to use an alternate Flight Termination Method, such as a parachute, then the details of such a system must be outlined in the Technical Report (Section 6.1). It is up to the team to convince the judges that the alternate system is safe.

## **5.7 Take-off and landing**

Teams must be capable of executing takeoff and landing from a rough mown grass runway.

## **5.8 Criteria for Flight Termination**

The Range Safety judges can demand that the flight be terminated if they deem that the aircraft is out of control.

### **The UAV Controller must comply without delay or argument.**

The team will be disqualified if the flight termination mode is selected.

## **5.9 Team Sponsors**

Teams must advise the organising committee of their sponsors and the terms of the sponsorship. Full disclosure of sponsors must be provided as part of the technical report. Sponsors should be aware that footage of a team's aircraft and team members could form part of the official UAV Outback Challenge documentary and promotional material.

## **5.10 Liability and Insurance**

It will be mandatory for all teams to implement their own insurance, including Public Liability insurance for both flight testing and competition flights. The organising committee will require evidence of a Certificate of Currency from each team.

Information on insurance required and insurance that can be purchased through the organisers of the competition will be available on the UAV Outback Challenge official website.

## **5.11 Loss of UAV Controller**

In the case that a team's designated UAV Controller (pilot) is unable to fly the aircraft on the competition or scrutineering day for any reason (such as sickness,

etc), then the judges have the discretion to allow another suitably qualified pilot (Section 5.2) to take their place. The replacement must also be a current high-school student.

## **5.12 Sharing of Equipment between Teams**

Teams may not share airframes.

Teams may share avionics, piece parts and ancillary equipment. If a part is swapped between teams, the aircraft must be re-scrutineered. Records should be kept of items that are exchanged, from both the perspective of the donor and the recipient, including serial numbers (where they exist), make, model, etc.

Sharing of equipment is not possible if two teams run consecutively due to timing issues.

The sharing provision exists to assist teams that may suffer equipment damage while travelling or at the Challenge.

## **5.13 Modifications After Technical Report Submission**

Minor modifications to the aircraft and systems will be allowed between the submission of the technical report and the day of competition, but these must be highlighted to the judges during the oral presentation (section 6.2) and will be subject to the discretion of the scrutineers (section 5.3).

In the event of the necessity to rebuild a system between the submission of the technical report and the day of competition, the system used in the competition should be that described in the technical report subject to any minor modifications as in the preceding paragraph.

Major modifications such as a complete system redesign or usage of an aircraft of different design may result in reassessment of the technical report with those sections no longer relevant (potentially up to the entire report) being disregarded and no points scored.

## **5.14 Spectrum Management**

Spectrum compliance is an issue that the organisers of the UAV Challenge take very seriously. It is the responsibility of each team to ensure their UAV operations are compliant with the ACMA regulations and further information to assist competitors in this is included in section 8.

Spectrum management rules are in place to provide each team with a fair and equal opportunity to compete. The general principal is that when teams are being assessed, such as during static scrutineering, flight scrutineering and competition flights all transmitting equipment should be switched off.

Specific details of spectrum management will be provided at the Challenge, but the following information can be used as a pre-event guide to how it will operate.

### **5.14.1 The RF Football**

At times when the switching on of transmitting equipment is controlled, only the team in possession of the Radio Frequency (RF) Football are permitted to switch on transmitting equipment. Teams without the RF football are not permitted to switch on transmitters or aircraft (as many aircraft may contain video transmitters), and violations of this rule will be treated harshly.

### **5.14.2 Transmitter Pound**

During flight scrutineering and competition flights teams will be required to place their transmitters into the transmitter pound and will only be able to access them during their flight or competition time slot.

### **5.14.3 Tinker Time**

At specific, designated times all teams will be permitted to switch on their transmitting equipment to test and setup their aircraft and systems. As all teams will be able to switch equipment on at the same time teams must accept and plan for the potential of interference during this time.

## 6 Judging

A team of at least three judges will determine compliance with all rules. Judges will be professional staff from within the UAV industry. Official times and measurements will be determined by the judges.

The judges will evaluate and score each of three elements, which will form the total Team score. The three elements are as follows:

- Technical Report : max 15 points
- Oral Presentation: max 15 points
- Flight Performance: max 90 points

The technical report and oral presentation must be completed prior to the team's mission flight. All decisions by the Competition Judges are final. There are a total of 120 points for the Airborne Delivery Challenge.

### 6.1 Technical Report and Video

Each Team is required to electronically submit a Technical Report in PDF format and a flight demonstration video in a common video format.

**The technical report and video MUST be submitted on or before August 24, 2011.**

The technical report must use the following headings:

1. Executive Summary (1 page)
2. Introduction (1 page)
3. Design Approach and Rationale (3 pages)
4. Risk Management Approach (2 pages)
5. Flight Test Results and Discussion (2 pages)
6. Conclusions (1 page)

One page is also allowed for the title page and one for that table of contents (gives total maximum page count of 12). No appendices are allowed.

The report and video will be assessed as follows:

| <b>Technical Report and Video (total of 15 Points)</b> |                         |
|--|-------------------------|
| <b>Scoring Components</b>                              | <b>Max Points</b>       |
| Executive Summary                                      | 2                       |
| Design approach and rationale                          | 2                       |
| Risk Management Approach                               | 2                       |
| Flight test results and discussion                     | 2                       |
| Quality of writing                                     | 3                       |
| Overall style/presentation                             | 2                       |
| Overall quality of video                               | 2                       |
| Late submissions                                       | MINUS 5 points per day  |
| Over page limit (12 pages)                             | MINUS 2 points per page |

**Note to Teams: CASA will be given copies of the technical report as part of the compliance information for the Challenge event. CASA reserves the right to check teams at the competition to ensure that their aircraft are as described by the technical report and that teams are performing the safety procedures they outline in the technical report correctly.**

**Teams must also submit a statement of originality as detailed in section 9 with their technical report.**

## 6.2 Oral Presentation

Each Team will deliver a presentation (not exceeding 10 minutes, plus 5 minutes of questions from the judges) highlighting:

- their approach,
- system design,
- any system changes since submission of the technical report,
- expected performance and
- what they have learned from the process.

Unique or innovative features and safety approaches should be included. Judging will be based on briefing effectiveness.

Each team will be allocated a presentation time (when they register at Kingaroy airport on the first day of the Challenge flying event).

**Teams MUST be ready to present at their allocated time.**

All presentations will finish at the end of the allocated time slot regardless of when they started. For example, if a team is 5 minutes late, they will only have 5 minutes to present.

**Teams MUST supply their own laptop with the presentation loaded. Challenge organisers will provide a VGA projector and screen. Teams must test their computer compatibility with the data projector at registration.**

The presentation will be assessed as follows:

| <b>Presentation (total of 15 Points)</b>                     |                   |
|--|-------------------|
| <b>Scoring Components</b>                                    | <b>Max Points</b> |
| Quality and clarity of the oral presentation                 | 3                 |
| Quality and clarity of the presentation slides               | 3                 |
| Does the presentation convey the overall team's achievements | 4                 |
| Ability to answer questions                                  | 5                 |

## 6.3 Mission Performance (Flying)

Each team will demonstrate their ability to deliver a rescue package to Outback Joe in a single 20 minute session for Airborne Delivery Challenge. Teams will be invited out onto the flying field and given three identical "packages" that conform to the

specification given in Section 2.1. Teams will then perform the Airborne Delivery mission as outlined in Sections 2 and 5.

For the Airborne Delivery Challenge, the mission performance will be assessed as follows:

| <b>Airborne Delivery Challenge (maximum of 90 Points)</b>  |  |
|--|--|
| <b>Scoring Components</b>  | <b>Max Points</b>  |
| Pre-flight checks, team communication and organisation, and demonstration of good judgement (airmanship)   | 15   |
| Landing (safety, controllability and condition of the aircraft)  | 5  |
| Accuracy of 3 drops, measured from where they rest: <ul style="list-style-type: none"><li>• Less than 2m from Joe: 20 pts</li><li>• Greater than 2m, less than 4m from Joe: 16 points</li><li>• Greater than 4m, less than 6m from Joe: 12 points</li><li>• Greater than 6m, less than 8m from Joe: 8 points</li><li>• Greater than 8m, less than 10m from Joe: 4 points</li><li>• Greater than 10m from Joe: 0 points</li></ul> | 3 x 20 points  |
| Bonus points for autonomous drop trigger if at least a single drop lands less than 10 metres from Joe  | 10 points  |
| Time penalty   | Minus 10 points for each minute over 20 minutes on the field |
| Exiting the flying zone (excluding the no-fly zone)  | Minus 10 points per breach                                   |

## 6.4 Rule Infringements

In the event of a team being found to have infringed a rule the following penalties may be applied at the Judges discretion:

1. The team may be disqualified
2. A maximum of 25 points per infringement may be deducted from the team's points total

If an infringement is found to be contrary to the spirit of the competition, giving the team a significant advantage or posing an unacceptable safety risk then disqualification is a likely outcome.

The most likely causes of infringements will be issues found during static scrutineering and in such cases teams will be given opportunity to rectify or resolve the issue and keep within the rules. At the judges and discretion teams will be given fair time to rectify the issue if possible without impacting on The Challenge schedule or providing the team with unequal treatment.

## 7 Awarding of Prizes

For the Airborne Delivery Challenge the teams with the highest points totals will be awarded the prizes listed in section 2.9, **provided that the teams also flew at the competition and dropped at least one package within 10m of Outback Joe.**

Australian high school students may enter the competition without the approval of their schools (and be entitled to the full cash prize themselves), however they must do all the work in their own time (not school time) and obtain insurance themselves.

If project work is conducted in school time with school resources and cost subsidised by the school, prize money will be awarded directly to the school.

## 8 Guidelines for Spectrum Compliance

The following information has been summarised from the official ACMA website (refer below) and correspondence with the Authority, on behalf of the UAV Challenge Organising Committee for the UAV Outback Challenge.

Please note that the following information should only be considered as GUIDELINES designed to assist competitors in understanding the issue of spectrum compliance. Each team should ensure they understand and comply with all relevant spectrum regulations prior to their Flight Readiness Review.

### 8.1 The ACMA, Spectral Planning and Licensing

The Australian Communications and Media Authority (ACMA) are the Australian federal regulatory body responsible for radio-communications compliance and manage the access to the radiofrequency spectrum within Australia.

As an independent Statutory Authority to the Commonwealth of Australia, the ACMA manages the spectrum in accordance with the Radiocommunications Act 1992, as outlined by the Ministry of Communications, Information Technology and the Arts.

While the ACMA encourages competitiveness and self-regulation of the RF spectrum, spectral planning provides the overall Statutory framework for the allocation and administration of radiofrequency transmissions for different types of services, as granted under the Act. This is done to maximise the efficient use of the spectral resource and minimise interference of adjacent channels.

The Australian Radiofrequency Spectrum Plan (ARSF)2009 is the latest spectrum plan used in Australia and is based upon the outcomes of the International Telecommunication Union (ITU) World Radiocommunication Conferences. As Australia is an obligatory member of the ITU, the ARSF must be drafted so that it takes into account the spectral allocations moved by the ITU.

The ARSF is used in conjunction with frequency and administrative band plans to structure the available RF spectrum for use within Australia.

In order to utilise the RF spectrum, a relevant licence must be obtained from the ACMA for anyone who makes use of a transmitter, as implied under the Act. The licensing of operators using RF devices falls under several different categories:

Apparatus Licence – based on the type of service provided by the communication link.

Spectrum Licence – based on the area the communication link is routed.

Class Licence.

Both Apparatus and Spectrum Licences are issued on an individual basis and there are subsequent Licence fees incurred, as well as the need for direct consultation with the ACMA by the licensee over the terms and conditions of the Licence.

Class Licences cover designated parts of the spectrum set aside for shared access by the general populous. Users of devices under a Class Licence conform to a common set of conditions applicable to all users and do not need to register or pay the ACMA for the Licence.

Under the current regulatory framework, there are no “un-licensed” bands for RF communication purposes.

All radiofrequency bands are subject to frequency and power restrictions, as defined within the applicable Licence category. This includes Class Licences.

## **8.2 Class Licensing and The Challenge**

Class Licences are a common choice of Licence given the ease of their use and the wide range of readily-available communication devices that fall within the operational conditions of the various Licences.

Class Licences vary according to the type of services provisioned under the Licences, the bandwidth of frequencies each Licence is defined over and the maximum allowable transmitted power over that bandwidth.

As such, not all Class Licences are applicable for UAV operations from legal, technical and safety perspectives.

The Technical Committee has deemed the following Class Licences, or parts thereof, applicable to the UAV Challenge for competitors to use in their link budget designs:

Radiocommunications (Low Interference Potential Devices) Class Licence 2000

Radiocommunications (Radio-Controlled Models) Class Licence 2002

## **8.3 Guidelines for Using Class Licences**

Competitors are entitled to use the aforementioned Class Licences for their radio links, on the provision that they act in accordance with the conditions defined under the Licence.

In general, this requires competitors to conform to:

The class of transmitter specified by the Licence (eg. Digital modulation, Frequency hopping).

The maximum radiated power for that frequency band. This is usually expressed in Effective Isotropic Radiated Power (EIRP).

If competitors fail to meet the conditions specified by the Class Licence, they are no longer deemed to be acting in accordance with it. Unless competitors gain another type of Licence from the ACMA to do so, it is classified under the Act as an illegal activity.

The ACMA has stated to the Technical Committee that devices used under the Radio communications (Low Interference Potential Devices) Class Licence 2000 must be low interference. They are within their right, should circumstantial evidence be provided, to turn off any transmitter causing potential interference and prevent further usage of the offending device.

## **8.4 ISM Frequencies**

Several of the Industrial, Scientific and Medical (ISM) bands fall under the Radio communications (Low Interference Potential Devices) Class Licence 2000 and devices used for radio communication purposes across these frequency bands are subject to the provisions outlined by the Class Licence.

It should be noted that the frequency range for the 900MHz ISM band for Region 3 (Australia) is different to other parts of the world and competitors should take this into consideration when designing their system.

Furthermore, the ACMA warns that radio communication services operating over ISM frequencies cannot be afforded protection from interference caused by non-radio communication ISM applications. As such, the suitability of using ISM bands for radio applications should be assessed by competitors (refer NOTE § 3 of the LIPD Class Licence).

## **8.5 FINAL NOTE TO COMPETITORS**

Spectrum compliance is an issue that the organisers of the UAV Challenge take very seriously.

It is the responsibility of each team to ensure their UAV operations are spectrum compliant for the UAV Challenge.

Failure to comply with any of the rules in Section 5.14 may result in team disqualification or other appropriate penalties (at the judges discretion).

For more information regarding spectrum planning, licensing and frequency allocation, please refer to the ACMA website available at:

[www.acma.gov.au](http://www.acma.gov.au)

## 9 Originality

It is expected that parents, teachers and other supporting adults will provide technical advice, mentoring and organisational assistance but it should be recognised that they are not members of the entering team.

Each team is required to submit a statement of originality as given below with their technical report, signed by each team member.

### Statement of Originality and Accuracy

We declare that this report is entirely the work of the team members listed below, and has not previously been submitted by us, or others for this challenge or any other similar event.

We have acknowledged external material with appropriate references, quotes or notes to indicate its source.

We declare that this report is an accurate record of activities carried out by us in preparing for this specific challenge. The events, data and other material contained within this report actually occurred and have been fully detailed.

Team Member Name

Signature

Date

## 10 Disclaimer

This document is subject to change by the Challenge organisers. The current rules document will be available from the challenge website. Registered participants will be notified of any changes.