1 EMERGENCY PROCEDURES

Preventing Air Vehicle loss or damage depends on early recognition of dangerous flight conditions or malfunctions followed by appropriate corrective action. Accurate decision making also depends on a thorough understanding of system operation and behavior. Mission planning must include consideration for emergencies for each phase of the proposed flight. To the extent possible, planned courses of action for emergencies should be made before a flight begins.

During flight, both operators must maintain situational awareness and monitor data to notice anomalies as soon as they develop. The MO should always know the Air Vehicle position relative to hazards and be ready to give the VO headings and altitudes to fly to safety. During emergencies, the MO is responsible for assisting the VO through execution of the following tasks:

- Ensure recording device is capturing Air Vehicle and video data.
- Maintain awareness of vehicle position, altitude, and wind conditions.
- Assist VO with navigation.
- Communicate with other units (e.g. Airspace Control Authority).
- Complete Checklist items.

Those steps which must be performed immediately in order to minimize the probability of Air Vehicle damage are underlined and in bold print. These items are referred to as “Immediate Action Items.” Operators must be able to perform these steps without referencing the checklist or manual. Non-underlined steps should be accomplished with use of the checklist.

For ALL emergencies, if the Air Vehicle cannot maintain flight, command Autoland prior to impact in order to minimize Air Vehicle damage.

NOTE
The most important consideration during the execution of emergency procedures is safety of personnel. All procedures are subordinate to this requirement.

NOTE
Emergency procedures contained in this manual assume the LOL setting is Go To Rally.

NOTE
Ensure AVTracker or other recording device is recording flight data prior to each mission. This data may be required to recover the Air Vehicle in the event of an emergency.

1.1 Loss of Downlink

Loss of downlink is indicated by a loss of video, accompanied by a clock symbol in place of the Link Status Bar, with GPS and other data elements flashing. It is possible to have a progressive deterioration in video quality as the only indication of lost downlink. Loss of downlink may be a temporary condition caused by signal interference or the result of equipment malfunction. This condition may be independent of uplink condition.

WARNING
When location and/or control of Air Vehicle is in doubt, perform appropriate procedures to notify Airspace Control Authority and/or manned aircraft in the vicinity. Report last known location, heading, altitude and estimated flight time remaining on current battery power.

CAUTION
DO NOT try to fly back within reception range by commanding Home, or make inadvertent inputs to verify resulting action. Without downlink, there is no way to verify that the Air Vehicle has received this instruction. If unable to restore downlink promptly, delay in turning off transmitter in order to force LOL En Route Rally increases uncertainty of Air Vehicle position and flight status.

NOTE
Operate with an RVT whenever possible to provide an independent source of downlink.

1. **Switch to directional antenna, if required.**
2. **Check orientation of downlink antenna.**
3. **Command turn and climb** - if video or LSB return, continue mission as required.
4. **Turn off transmitter** - to force LOL Rally mode.
5. If video returns, turn ON radio transmitter, take control of Air Vehicle and continue mission as required.
6. If link does not return, MO:

    a. Ensure AVTracker is recording
    b. Monitor Air Vehicle Location - note position, heading and altitude
    c. Record GPS coordinates when Autoland message is received.

1.2 Loss of Uplink

Loss of uplink is indicated by a clock symbol in place of the Link Status Bar (LSB), with no items flashing. It is characterized by a lack of Air Vehicle response to GCS control inputs. After the Link Timeout setting expires, Air Vehicle will execute selected LOL mode. For 'Go To Rally' this will be indicated by "En Route Rally" displayed on the Hand Controller and "En Route Rally" also displayed flashing red in the upper left corner of FalconView on the GCS Laptop. LOL is also indicated by the camera moving to a forward-look position (30°down). The payload will automatically stow when Air Vehicle reaches waypoint E en route to L and is less than 150 ft. AGL.

CAUTION
When location and/or control of Air Vehicle is in doubt, perform appropriate procedures to notify Airspace Control Authority and/or manned aircraft in the vicinity. Report last known MGRS location, heading, altitude, and flight time remaining on current battery power.

1. Monitor LSB. If link is restored, enter flight mode, take control of Air Vehicle and continue mission as required.
2. If link is not restored, MO:

    a. Ensure AVTracker is recording
    b. Monitor Air Vehicle Location - note position, heading and altitude
    c. Record GPS coordinates when Autoland message is received.

1.3 GPS Failure

Loss of GPS is indicated by flashing data in all GPS related fields. It is distinguished from Loss of Downlink by good video and accurate display of non-GPS related fields on the GCS. MAN and ALT flight modes will continue to function normally. NAV, LOIT, and HOME modes are NOT functional with a GPS failure. In addition, the gimbaled payload locks to either front or side view when the Air Vehicle experiences a GPS failure.

The Air Vehicle must have functioning uplink and/or GPS to operate. The Air Vehicle can be guided in MAN or ALT mode without GPS, provided that the uplink is still functioning.

If GPS has been lost for greater than the GPS default setting and the Air Vehicle is already in LOL mode, or enters LOL mode then the Air Vehicle will automatically command AutoLand.

CAUTION
Do not force LOL during GPS failure. This will cause the Air Vehicle to AutoLand when GPS has been lost for greater than the GPS default setting (30 seconds).

CAUTION
Conducting a mission without GPS is a high-risk operation and is not recommended.

1. **Select ALT/MAN Mode.**
2. **Set CMD ALT/throttle to safe altitude.**
3. **Turn Air Vehicle toward GCS** - use back azimuth of last known Air Vehicle bearing or terrain association to fly toward landing site.
4. If GPS returns, continue mission as required.
5. Use GCS downlink patch antenna to estimate bearing to Air Vehicle.
6. If unable to execute Step 3., select suitable landing site and command AutoLand.
7. MO -
    a. Ensure AVTracker is recording
    b. Monitor Air Vehicle Location - note heading and altitude
8. Recover Air Vehicle. See Section 1.14.

1.4 Structural Failure (Loss of Components In Flight)

1. **Command Autoland.**
2. MO:
    a. Ensure AVTracker is recording
    b. Monitor Air Vehicle Location - note position, heading and altitude
    c. Record GPS coordinates when Autoland message is received.
3. Recover Air Vehicle.

1.5 Extreme Low Air Vehicle Battery

Air Vehicle battery voltage is always displayed. When the Air Vehicle voltage is reduced to 21.5 volts a warning is displayed next to this display on the GCS. Under optimal conditions, at 21.5 volts, the Air Vehicle only has approximately 15 minutes of flight time remaining. At 19 volts the Air Vehicle has less than one minute remaining and therefore should be landed immediately.

1. **Switch to MAN and use min. power.**
2. Recover Air Vehicle at Home location if able, or select suitable landing area.
3. AutoLand.
4. Record location.
5. Recover Air Vehicle.

1.6 Motor Power Failed Warning

A “Motor Power Failed” warning message indicates the battery is no longer providing power to the motor.

CAUTION
Autoland can be initiated at any time and from any altitude. Greater chance of Air Vehicle damage exists if Autoland is commanded at altitudes lower than 100 ft. AGL.

If “Motor Power Failed” warning message appears on the Hand Controller:

1. <u>Command Autoland</u>.
2. Push Hot Key to enter MAN mode.
3. If control is regained, continue mission.
4. If control is not regained, command Autoland.
5. Monitor Air Vehicle location and recover Air Vehicle, if possible.

1.7 No Hub Com Warning

A “No Hub Com” warning message indicates a communication failure.
A bad battery can cause this message. No Hub Com will cause the Air Vehicle to enter LOL. “En Route Rally” message will not appear.

If a “No Hub Com” warning message appears on the Hand Controller:

NOTE
Disconnecting and reconnecting batteries from Hub will cause a re-boot. Re-boot normally takes 5 seconds and will cause Air Vehicle data to be lost. Upon re-boot, transmitter is OFF (TX off). A restarted Hub will also command AutoLand.

1. Disconnect batteries from Hub Unit. Do not “hot-swap”.
2. Reconnect known-good batteries to Hub Unit.
3. If “No Hub Com” warning disappears, VO assume control of Air Vehicle.
    a. Push Hot Key to cancel AutoLand command.
    b. Select flight mode (MAN, ALT, HOME, LOIT, NAV).
    c. Turn ON transmitter.
    d. Establish/re-lock GCS with Air Vehicle.
    e. Press Enter button to abort Rally and accept flight mode changes.
    f. Reload Air Vehicle mission.

1.8 Hand Controller Fails

A Failed Hand Controller can be indicated in many ways. Typical symptoms include blank Hand Controller screen and no response to Hand Controller input.

NOTE
The system will default to transmitter off when Hand Controller is unplugged.

1. <u>Disconnect Hand Controller</u>. This will force LOL.
2. MO - Monitor Air Vehicle location.
3. Replace with spare Hand Controller.
4. If spare Hand Controller restores control, VO assume control of Air Vehicle.
    a. Select flight mode (MAN, ALT, HOME, LOIT, NAV).
    b. Turn ON transmitter.
    c. Establish/re-lock GCS with Air Vehicle.
    d. Press Enter button to abort Rally and accept flight mode changes.

10.9 Altitude Hold Failure

Altitude Hold Failure mode may be indicated by the Air Vehicle oscillating in pitch or by a significant deviation from assigned altitude.

CAUTION
In all flight modes except MAN, the Air Vehicle maintains altitude by sensing pressure. Failure to enter MAN mode may result in damage or loss of equipment.

1. <u>Enter MAN mode</u>.
2. Fly back to recovery site or continue mission in degraded mode.

10.10 Steady Turn Develops at Neutral Stick

1. <u>Return to base (RTB) if able</u>.
2. <u>If unable, command AutoLand</u>.
3. MO:
a. Ensure AVTracker is recording.
b. Monitor Air Vehicle Location - note position, heading and altitude.
c. Record GPS coordinates when Autoland message is received.

10.11 Air Vehicle Oscillates Up/Down or Right/Left

1. <u>Return to base (RTB) if able</u>.
2. <u>If unable, command AutoLand</u>.

3. MO:
    a. Ensure AVTracker is recording
    b. Monitor Air Vehicle Location - note position, heading and altitude
    c. Record GPS coordinates when Autoland message is received.

10.12 Gimbal Does Not Retract

Payload should fully retract 4 seconds after commanded to stow. Once complete, GSC screen will display "Payload Stowed". If this message does not appear, attempt to visually verify payload has not retracted.
1. Extend gimbal.
2. Attempt to retract.
3. If unsuccessful, select suitable landing site (water or soft surface, if able) and proceed with recovery; inspect payload postflight.

1.13 Mid-Air Avoidance

Low altitude aircraft may intrude on operating airspace without warning. Due to the Air Vehicle's low visual signature, manned aircraft may not be able to see and avoid in time to prevent collision. To minimize unnecessary risk, Air Vehicle operators should employ safe in route altitudes in areas with a high volume low altitude traffic.

Operator shall not deviate from approved/assigned altitudes without approval of Airspace Control Authority (ACA).

If low altitude aircraft unexpectedly approach mission area:

1. Estimate intruding aircraft altitude.
2. If aircraft is at or below Air Vehicle altitude, climb.
3. If aircraft is above Air Vehicle altitude, maintain or descend.
4. Contact ACA or aircraft on the air net as applicable.

1.14 Recovery of Downed Air Vehicle

1.14.1 Preserve Data
Record all last good Air Vehicle data before disconnecting GCS power. Make notes of operator's last actions and last observation of Air Vehicle video. Save video recording for review.

1.14.2 GCS/RVT as a Locator
The Puma-AE battery does not usually disconnect on landing. Therefore, the Air Vehicle may continue to transmit downlink signal for quite a long time after landing, as battery usage is significantly diminished after the motor is off. If the Air Vehicle enters AutoLand mode prior to landing, Video will not likely be available, however Air Vehicle downlink data may continue to transmit. Downlink antenna (directional) can be used as a direction finder. Air Vehicle is toward the direction that produces snow and/or results in data fields not flashing.