PILOT FLIGHT OPERATIONS EMERGENCY, CONTROL UPSET AND RECOVERY PROCEDURES
#GTMP-2030

Introduction: There are two emergency categories associated with turbine powered Remote Operated Aircraft. The category of emergency is defined according to where the model is located; either on the vehicle service cradle, usually located in the pit area (ground emergency), or on the tarmac / runway (flight emergency). The definition of flight emergency is inclusive of taxi, takeoff, in-flight maneuvers, landing approach, and landing.

Purpose: This document is intended to provide standard guidelines to be followed in the event of an emergency involving a turbine powered model. These guidelines are based on best practices recommended by the Academy of Model Aeronautics, turbine engine manufactures, and the experienced pilots who have flown many types of Remote Operated Aircraft.

Scope: These procedures shall be used for all turbine-powered models operated and/or supported by the AirSTAR project. **It shall be required that review and discussion of emergency procedures be included as part of the daily pre-flight briefing.** In the event of any model crash or fire beyond the capability of the emergency response team, or any situation that requires immediate medical attention, the nearest fire department will be called via “911”. As part of the required daily pilot briefing, all pilots will demonstrate engine emergency shutdown procedure to the satisfaction of the Chief Pilot. Spotters shall be briefed to relay information to observers with respect to pilot information during flight. This includes flight maneuvers (take off, pattern, stalls, spins, gear pass, and landing) and announcement of emergency in progress “heads up, we have an emergency”.

Ground Emergency

Procedures for engine fire during startup require the following actions: If fire should occur during start-up, immediately shut off the propane and ECU, leave the air on, if used for AMT engines. Fires will usually blow themselves out this way with little harm. If CO2 is needed, administer it through the model intake, about a foot away from the engine inlet (or bypass), and since the CO2 immediately warms to a gaseous state, this will smother the fire without engine damage. (Ref. AMT USA Turbine Operations Manual p. 4-2).

If fire should occur during engine run-up:

1. Pilot: will set engine(s) to idle
2. Firewatcher: will direct fire extinguisher CO_2 into inlet of engine
3. Ground Crew: will shut off fuel valve(s), and secure battery power OFF after fire is extinguished.

Flight Emergency

The three emergency flight categories are; controllability, fire, and landing gear. For controllability, and landing gear issues the pilot must first determine the degree of vehicle control, its potential energy (airspeed, altitude, engine(s) operation, fuel consumed, and fire onboard), and how/where to land.

1 Uncommanded vehicle response due to unknown failure (i.e. engine failure, control surface jam, etc.) while the **vehicle is airborne** require the following actions:

1. Pilot and/or spotter alert the pit area.

NOTE: If at any point in the flight where vehicle looses total control or fire is observed, immediately shut down the engine(s)

2. Attempt to reestablish controlled flight through application of control stick and/or trim inputs to stabilize the vehicle, turn off gyro gain if necessary, and check airspeed (should be greater than 70 and less than 120 mph). Select high-rates on all controls (if not in high-rate already). Pilot may request spotter to assist in setting transmitter switch configuration if necessary in order to maintain control of the vehicle.
    a. If insufficient control authority exists for stabilized flight: Select idle thrust, and revaluate.
    b. If insufficient control authority still exists or fire is observed: Engine shut down, attempt to pilot vehicle to secure area and minimize damage.
    c. If no response from vehicle, i.e. failsafe condition: activate backup transmitter (if available). Deactivate primary pilot transmitter and attempt to pilot vehicle.
    d. If sufficient control authority exists only at idle thrust: keep aircraft in clean configuration (no flaps or gear). Attempt a landing on the runway, delay gear deployment until flight to the runway is achievable. Deploy gear, and evaluate flap deployment and land aircraft. Be mentally prepared to ditch aircraft if control deteriorates to a less than adequate level.
    e. If landing on the runway is not possible: keep gear up, evaluate flap deployment. If vehicle is stable with flaps deployed: keep flaps deployed, land in best area possible to avoid risk to people on the ground, property, and minimize aircraft damage.
3. If sufficient control authority exists for stable controlled flight: Attempt to get aircraft into landing configuration. First deploy landing gear and re-evaluate, then select mid-flaps and re-evaluate, then landing flaps and re-evaluate. Select best configuration to attempt landing (i.e. clean, gear, mid-flaps + gear, landing flaps + gear).

4. Begin approach, when appropriate, using more conservative approach pattern (if possible). Allow for the opportunity to have the longest final approach as possible for best trim and control set up.
5. Mentally prepare to shut down engine(s) and ditch vehicle if control of vehicle deteriorates to a less than adequate condition prior to reaching the pit area.
6. If a go-around is needed: gradually apply thrust, retract gear, and set flaps as needed to maintain controllability.
7. Re-set aircraft into landing condition and re-attempt landing.

2. Uncommanded vehicle response due to unknown failure (i.e. engine failure, control surface jam, steering failure, etc.) while the **vehicle is on ground**:

1. Select idle thrust
2. Pilot aircraft to best area to avoid people and minimize aircraft damage.
3. Engine shutdown

3. Landing Gear Issues; where mechanical configuration is other than normal “gear down” in preparation for landing.

1. Evaluate landing gear configuration condition during gear pass.
2. If the landing gear will not deploy on command, cycle the command no more that two times
3. Attempt to aerodynamically deploy landing gear by performing high **±g** maneuvers (i.e., steep turns, loops, and stick doublets).
4. If landing gear deploys, perform gear pass to verify correct configuration and proceed with landing procedures (fuel permitting).
5. If landing gear will only partially deploy, perform gear up landing adjacent to runway providing surface is acceptable (smooth grass). If adjacent surface is not acceptable, continue with runway landing.
6. Once pilot commits to landing, immediately shutdown turbine(s) upon contact with the ground and deploy emergency crew. Pilot may request spotter to assist in setting transmitter switch configuration if necessary in order to maintain control of the vehicle.

Flight Maneuvers

1. Stalls and Spin Recovery –The AirSTAR pilot training curriculum requires proficiency and skill for stall and spin recovery. For training purposes, the altitude for the approach to stall maneuver shall be defined at the pilot safety briefing prior to the day’s operation. All maneuvers will begin with the vehicle pointing into the prevailing wind. In the absence of instrumentation to accurately measure altitude above the ground, the pilot and spotter, based on previous flight experience at this measured altitude, will visually determine appropriate altitude for maneuvers. Winds aloft shall not be greater than 40 miles per hour unless approved by the safety officer. In the event that stall onset is inadvertent due to wind gust or accelerated stall, the same recovery procedure shall

apply. The following are recommended basic recovery inputs to first indications of a stall, with due considerations of characteristics peculiar to specific vehicle types:

Simultaneously:

1. Pitch Control - positive pitch reduction as necessary to reduce wing angle of attack, and to accelerate the aircraft (increase airspeed)
2. Thrust (or Power) - apply maximum available
3. Rudder - control yaw with care

After the initial actions have been taken:

4. Speed brakes - ensure stowed
5. Roll attitude - roll to wings level
6. Pitch Control - as necessary to avoid recurrence of secondary stall and to minimize the altitude loss, with due consideration of proximity to terrain.
7. Configuration - check appropriate. Some actions such as gear retraction increase drag during the gear retraction sequence and delay stall recovery.
8. At all times handling of aircraft should be in a smooth, deliberate and positive manner. Avoid increasing load factors until a minimum maneuvering speed has been achieved.

2. Spins and Recovery - Spin training must be accomplished similar to stall training given the same requirements for altitude, and winds aloft. Before practicing intentional spins, the pilot(s) will review procedure for the proper entry and recovery techniques. Pilots should also be knowledgeable of any additional information on spin characteristics unique to the vehicle (Appendix A, ASRB FSR GTMP-1324ASRB Approval List). Spin avoidance, incipient spins, and actual spin entry, spin, and spin recovery techniques should be practiced from an altitude that will enable complete recovery by 200 feet AGL. Continue airspeed indication call outs, if available, during the spin recovery to ensure that it does not experience a secondary spin. General spin recovery techniques for most aircraft consist of:

1. retarding power to idle,
2. neutralizing the ailerons,
3. applying opposite rudder to the direction of rotation,
4. applying positive forward-elevator movement to break the stall,
5. neutralizing the rudder as the spinning stops, and returning to level flight.

The spin characteristics will vary between vehicle types and even between different aircraft of the same type. One aircraft may enter and recover from a spin promptly while another aircraft of the same type may enter a spin with difficulty or require a more aggressive recovery technique. This is due to various factors such as the weight and balance of the aircraft and the rigging of the controls and wings. For this reason caution should be exercised when practicing spins in a variety of aircraft.

Appendix A

AirSTAR / GTM UAV Inventory and ASRB Approval

Vehicle	Manufacturer	Wingspan	Wing Area	Length	Weight (Dry)	Fuel Capacity	Fuel Type	Gross Wight	Speed (mph)	Propulsion	Total Thrust	Thrust : Weight	Flight Time	Wing Loading
Identification / Owner	Name	inches	sq. inches	inches	lbs	ounces	K1, Nitro, Gas	lbs	mph	Type	lbs(f)	Ratio	Minutes	oz./ft2
DV8R Turbine Trainer / VCU	PCM Models	84.0	UNK	87.0	27.0	100	K1	32.2	150	JetCat P-80	18	0.56	10	~50
KingCat Navy / NASA	BVM Jets	94.0	1556	84.0	33.0	163	K1	41.5	200	JetCat P-120	27	0.65	12	60.0
KingCat Stars / NASA	BVM Jets	94.0	1556	84.0	30.0	163	K1	38.5	200	JetCat P-120	27	0.70	12	~55
Ultra Stick 120 / NASA	Hanger 9	76.0	1230	60.6	11.0	22	Nitro	14.0	85	OS 1.4 (3.5 HP)	~10	0.71	12	27.7
F100F / NASA	BVM Jets	69.0	1223	83.5	38.1	203	K1	48.6	> 200	Olympous 450	43	0.71	8	90.4
FJ2 Fury / NASA	BVM Jets	37.5	738.72	37.5	19.0	72	K1	21.6	175	JetCat P-70	16	0.74	8	67.5
L1011 S1 / NASA	PCM Models	85.0	1014.6	86.0	32.8	124	K1	37.9	135	JetCat P-120	27	0.71	12	86.1
L1011 S2 / NASA	PCM Models	85.0	1014.6	86.0	33.3	124	K1	39.7	135	JetCat P-120	27	0.68	12	90.2
L1011 Mod2 D1 / NASA (No Longer in Service)	PCM Models	85.0	1014.6	86.0	46.7	256	K1	60.0	135	2 ea. JetCat P-70's	32	0.53	12	136.3
L1011 D2 / NASA	PCM Models	85.0	1014.6	86.0	46.7	256	K1	60.0	135	2 ea. JetCat P-70's	32	0.53	12	136.3
L1011 D3 / NASA	PCM Models	85.0	1014.6	86.0	46.7	256	K1	60.0	135	2 ea. JetCat P-70's	32	0.53	12	136.3
GTM T1 / NASA	NASA	94.0	868.32	96.0	43.8	218	K1	55.0	120	2ea. AMT 180's	44	0.80	13	145.9
GTM T2 / NASA	NASA	94.0	868.32	96.0	43.8	218	K1	55.0	120	2ea. AMT 180's	44	0.80	13	145.9
33% Edge 540 # 21 / NASA	Hanger 9	97.5	1730.6	85.0	22.5	32	Gas	25.0	60	Zenoah 80 (6 HP)	~18	0.72	10	33.3
33% Edge 540 # 22 / NASA	Hanger 9	97.5	1730.6	85.0	22.5	32	Gas	25.0	60	Zenoah 80 (6 HP)	~18	0.72	10	33.3
T33 / NASA (No Longer in Service)	BVM Jets	72.0	810	69.0	22.6	81	K1	25.6	180	AMT 180 SP	22	0.86	8	72.9
MIG 117 / NASA, VCU	Goldberg	67.0	800	74.0	13.3	32	Nitro	15.0	74	OS 91 (2.8 HP)	~12	~.5	20	43.2
Eurosport / VCU	Composit-ARF	66.0	UNK	94.0	24.0	120	K1	30.0	150	JetCat P-120	27	0.90	12	~50
33% J3 Cub / NASA	ModelTech	132.0	2508	90.0	24.0	32	Gas	30.0	50	Zenoah 80	~18	~.5	10	27.6
Viper	Great Planes	52.0	504	41.3	3.0	6	Nitro	3.4	120	OS .46	~4	>1	8	15.5
Sailplane DG - 600 M 4-4.8m scale 1:3.75	ICARE	189.0	1162	72.0	10.3	na	na	na		Electric			20	20.0
Sailplane Eraser 2000, Xtrem	ICARE	124.0	1054		6.2	na	na	na		Electric			20	10.5