Lost Link Aircraft Maneuvers – Flight Manual Description

NASA DFRC 2007 Fire Mission
UAS COA Application Attachment

From MQ-9A Preliminary Flight Manual, 21 Aug 2006
Figure 1-61 Pasted from .pdf version into Microsoft Word, and reformatted to make it more understandable.

Changes from the "-1" are identified as "tracked changes" and the following that do not show up as "tracked changes":
1. "Boxes" around each step
2. Step names in "Bold" for each Process Box.

Lost Link Aircraft Maneuvers.

Time/Condition	Process
LOS Datalink: 0 to 2 seconds lost link. **DLOS Datalink**: 0 to 5 seconds lost link. **Ku-Band Datalink, Launch & Recovery Mode:** 0 to 2 seconds lost link. **Ku-Band Datalink, Cruise Mode:** 0 to 10 seconds lost link.	**Arming Time.** The RCM waits to see if it is a temporary dropout. The autopilot flies the aircraft based on its last input commands. **NOTE** More arming time is allowed for Ku-band datalink in Cruise Mode because the aircraft is expected to be above 2000 ft AGL altitude.
If aircraft altitude is at or above initial lost link altitude minus 200 feet: From Arming time to +0.02 Seconds.	**Heading Hold:** • Set heading hold to the initial lost link heading for 0.02 seconds. • Continue to use the airspeed, alpha, and altitude sensors that were selected before entering lost link. Continues stall protect in previous state (On or Off). • Sets fuel system to automatic mode. • If Outside Air Temperature (OAT) is above 10°C, set pitot tube and static port heaters Off (to conserve electrical power). • If OAT is below 10° C, set anti-ice system (if installed) to automatic operation: Sets pitot heat On, static port heat On, and nose lens heat to On and 35% duty cycle. • Set flaps to zero degrees. • Turns Off fuel dump. • Turns Off transponder ident function.

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Time/Condition	Process
If aircraft altitude is less than initial lost link altitude minus 200 feet: From Arming time to +51 Seconds.	**Heading Hold (con't):** • Sets Heading Hold to the Initial Lost Link Heading. • If airspeed is above 105 KIAS or altitude is greater than 10k, set airspeed hold to 105 KIAS. • If altitude is under 10k and airspeed is less than 105 KIAS, set pitch to 2°, else set airspeed hold to 105 KIAS. • Set throttle to maximum allowable based on altitude. • Set roll/pitch/yaw SAS to On. • Continue to use the airspeed, alpha, and altitude sensors that were selected before entering lost link. Continues stall protect in previous state (On or Off). • Sets fuel system to automatic mode. • If OAT is above 10°C, set pitot tube and static port heaters Off (to conserve electrical power). • If OAT is below 10° C, set anti-ice system (if installed) to automatic operation: Sets pitot heat On, static port heat On, and nose lens heat to On and 35% duty cycle. • Set flaps to zero degrees. • Turns Off fuel dump. • Turns Off transponder ident function.
From arming time + heading hold time. To arming time + heading hold time + loiter climb.	**Loiter Climb:** 1. The aircraft flies a circular loiter pattern (3-mile diameter) **NOTE** If heading hold was flown for 0.02 seconds, loiter will be centered on lost link location. If heading hold was flown for 51 seconds, loiter will be centered on a point 2.5 miles from lost link point in direction of lost link heading. 2. Set altitude hold to the initial lost link altitude. Continue airspeed hold at 105 KIAS. **NOTE** If the aircraft has not reached the loiter pattern after the first 51 seconds, the aircraft will climb/descend to Initial Lost Link Altitude (ILLA) while en route to the loiter. If the aircraft is above the ILLA upon reaching the loiter pattern, it will immediately turn to the entry waypoint of the emergency mission. If the aircraft is below the ILLA upon reaching the loiter pattern, it will execute the loiter pattern.

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Time/Condition	Process
From arming time + (heading hold time) + (loiter climb) to initial waypoint reached.	**Emergency Mission entry waypoint** • The autopilot proceeds to fly the aircraft to the entry waypoint in the emergency mission. Airspeed, altitude and other flight parameters will be as set for the entry waypoint. • Set SAR to Off if it is installed. **NOTE** At this point, if no lost link mission has been preprogrammed, the RCM will initiate the "No Emergency Mission Loaded" flight termination process (see procedures below).
Initial waypoint reached.	When the aircraft reaches the initial waypoint in the emergency mission, it begins to execute the mission. Airspeed, altitude, etc. will be as programmed for the mission.
Next-to-last waypoint reached.	When the aircraft passes the next-to-last waypoint in the emergency mission, a 96-hour timer is set. When the last waypoint is reached, continuously repeats the final six waypoints of the mission.
If no emergency mission is loaded: flight termination procedures.	The aircraft will stay in the loiter pattern over the GCS and fly at lost link altitude until mission time is over (96 hours or when out of fuel).
96-hour timer complete or when out of fuel.	The RCM kills the engine and lowers the landing gear. The autopilot attempts to fly the aircraft as though it was executing the emergency mission while the aircraft descends, except it commands an airspeed of stall + 15 knots.

Preliminary Flight Manual Figure 1-61

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