

## Communications Description

### NASA DFRC 2007 Fire Mission UAS COA Application Attachment

NASA Dryden Flight Research Center (DFRC) has procured from General Atomics – Aeronautical Systems Incorporated, an MQ-9 Reaper aircraft and a Ground Control Station (GCS). DFRC has assigned the number “NASA 870” to the aircraft and renamed it “Ikhana” (pronounced ee-kah-nah , a Native American word from the Choctaw Nation meaning intelligent, conscious, or aware).

This attachment covers the communication between the Ikhana pilot in the GCS and the aircraft for command/control and telemetry. Attachment NASA 2007 Fire Mission - Communication and Lost Communication Description Attachment describes the communication between the Ikhana pilot and ATC.

The Ikhana aircraft and GCS have standard General Atomics MQ-9 command, control, and telemetry communications devices. NASA DFRC has made modifications to the GCS intercom system to provide capabilities necessary for NASA research missions.

1. **Aircraft Command, Control and Telemetry** – The Ikhana aircraft is controlled during flight by the 2 standard MQ-9 methods; a line of sight (LOS) C-band system, and an over the horizon (OTH) Ku SatCom system.
  - 1.1. **LOS C-band system** – Ikhana uses the standard MQ-9 C-band LOS command and telemetry system with portable ground data terminals (PGDT's) for antennas. The C-band system is controlled by the pilot in the GCS.
  - 1.2. **OTH Ku SatCom system** – Ikhana uses the standard MQ-9 Ku band OTH SatCom command and telemetry system with a mobile 4.5 meter dish Ku SatCom ground station. The Ku SatCom system is controlled by the pilot and other personnel inside the GCS.
2. **ATC Communication** – Ikhana uses the standard MQ-9 ATC communication systems to communicate with ATC with the addition of telephones as a backup method.
  - 2.1. **GCS Pilot** – The GCS is designed to provide instantaneous, or near instantaneous two-way communication with ATC at all times and provides a backup method of communication using telephones.
    - 2.1.1. **GCS UHF/VHF transmitter** – The GCS contains a standard UHF/VHF radio for communication with ATC near the GCS (the ATC near the GCS would be Edwards, AFB ATC) for instantaneous 2 way communication with ATC, the airborne chase/observer, and ground chase/observer.

2.1.2. **Airborne Relay Through the Aircraft** – The GCS and Ikhana aircraft contain the standard MQ-9 capabilities to use the aircraft as an airborne relay for ATC communications. This system uses a single ARC-210 UHF/VHF radio in the aircraft to talk to ATC wherever the aircraft may be. This system is in-flight tunable and has Guard capabilities. Because this is a single radio in the aircraft, the pilot can talk/monitor 1 radio frequency at a time.

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2.1.3. **Telephone** – The pilot in the GCS can use telephones located in the GCS as a backup method for communicating with ATC if other radio methods are not operating. In a lost link situation, the pilot will notify the appropriate ATC supervisor that the aircraft is lost link via telephones. When the aircraft is lost link, all communications with ATC will be through the telephone.

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2.2. **Airborne chase pilot and observer** – The GCS pilot will communicate with the airborne chase pilot and observer using the GCS UHF/VHF or aircraft airborne relay capability.

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2.3. **Ground Observer Personnel** – For operations where ground observers are necessary, the GCS pilot will communicate with the ground observer using the GCS UHF/VHF radio capability.

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3. **Ground Control Station (GCS)** – Additional communication capabilities have been built into the GCS by NASA DFRC. These capabilities can be divided into intercom and data communications capabilities.

3.1. **Intercom** – It is critical during all NASA flight operations that the personnel involved have appropriate intercom capabilities to perform missions safely. The GCS has been modified by NASA DFRC to provide the appropriate intercom and voice recording capabilities to do this. This includes the capability to record appropriate voice communications. The intercom system is designed to provide multiple voice “loops” so that GCS personnel can efficiently communicate in time critical and non-time critical modes without causing an unacceptable workload burden. All intercom stations have the ability to control the loops they are listening to, as well as the loop they are talking on. An intercom system administrator sets up the default system configuration of loops, permissions, and recording attributes. The system configuration can be modified in real time to enable/disable loops, and permissions as necessary.

3.1.1. **Flight Crew Intercom** – Using the intercom system, the crew has direct control to isolate their communications between themselves, or to listen/join into communications between other personnel in the GCS. This capability is be limited by the loop and permissions configuration under the control of the

intercom system administrator. Other personnel in the GCS can not force communications with the crew without crew consent and approval.

3.1.2. **Other GCS Personnel Intercom** – Using the intercom system, other personnel in the GCS have the ability to listen/join into communications between other personnel in the GCS. This capability is be limited by the loop and permissions configuration under the control of the intercom system administrator.

3.1.3. **Ground Support Personnel Intercom** – Using the intercom system, the pilots and other personnel in the GCS have the ability to communicate with aircraft ground support personnel working on the aircraft. This capability is be limited by the loop and permissions configuration under the control of the intercom system administrator.

3.2. **Research/Science Data Communication** – The GCS also has the ability to communicate aircraft systems and research/science data from the aircraft to various locations inside and outside the GCS.

3.2.1. **Inside the GCS** – NASA DFRC has augmented the standard MQ-9 data communications systems to provide appropriate information to each workstation in the GCS. These modifications are modeled on traditional DFRC control room systems, were designed and implemented with standard DFRC configuration control, inspection, and Information Technology (IT) computer security oversight.

3.2.2. **Outside the GCS** - NASA DFRC has augmented the standard MQ-9 data communications systems to provide appropriate information to researchers/scientists and other personnel outside of the GCS. These modifications are designed and implemented with standard DFRC configuration control, inspection, and Information Technology (IT) computer security oversight.