# NAS Operational Capability for Detection of Other Aircraft 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 is intended to describe the NAS Operational Capabilities of Ikhana to detect other aircraft during the 2007 WSFM operations.

1. **Air Traffic Control (ATC) Detection of Ikhana** –

    1.1. **Mode C transponder –** Ikhana has a Raytheon APX-119 IFF Digital Transponder (TSO Certified to TSO-C112) installed with Mode C capability. Although this hardware also has Mode S capability, the software loaded in the aircraft/GCS is not able to utilize the Mode S capability (yet).

2. **Ikhana Detection Of Other Aircraft -**

    2.1. **Pilot Using Forward Cameras** – The pilot can use the 2 standard MQ-9 fixed forward cameras to provide a limited capability to detect other aircraft. One camera is daylight, the other has infra-red (IR) capability.

        2.1.1. **Daylight Forward Camera**
            2.1.1.1. Fixed, no pan or tilt capability
            2.1.1.2. 30° field of view
            2.1.1.3. Zoom capable, but fixed during flight
            2.1.1.4. Resolution of sensor array 768 x 494 pixels.
            2.1.1.5. Automatic iris
            2.1.1.6. Camera not effective for low light or intensely bright conditions
            2.1.1.7. Camera lens heat capability controlled by the pilot.

        **2.1.2. Infra-red (IR) Forward Camera**
            2.1.2.1. Fixed, no pan or tilt capability
            2.1.2.2. With 25 mm lens for a 36° x 27° field of view
            2.1.2.3. Zoom capable, but fixed during flight
            2.1.2.4. Resolution of sensor array 320 x 240 pixels.
            2.1.2.5. Beryllium strontium titanate (BST) focal plane array sensitive to 7 to 14 micrometers (microns)
            2.1.2.6. Automatic iris
            2.1.2.7. Camera lens heat capability controlled by the pilot.

2.2. **Automatic** - The aircraft has no automatic electronic means to detect other aircraft.

## 3. FAA COA Checklist V-6 (Revision 5, 6-15-2005) questions

17.a. Radar Observation

a. What types/models of radar are being used to detect other airborne operations? A : The aircraft contains no on-board radar capability.

b. Are the radar ground or airborne based? A: N/A

c. What kind of communications will exist between the radar observer and UA pilot? (I.e. direct, instantaneous, "open-line", delayed, etc.) A: N/A.

d. What are the skills, knowledge, and certifications of the radar observer to detect other airborne operations? (I.e. Familiarity with FARs, AT operations and procedures, etc.) A: N/A.

e. How many aircraft will the radar observer be responsible for monitoring simultaneously? A: N/A.

f. Will the radar observer also pilot the UA? A: N/A.

g. What is the reliability of the radar system, communications system, and other supporting systems being used by the radar observer? A: N/A.

h. What is the legal connection between the radar observers and the proponent's organization? A: N/A.

17.b Forward or Side Looking cameras.

a. What types or models of cameras are being used to detect other airborne operations? A: Standard MQ-9: 2 fixed, forward looking cameras (1 daylight, 1 IR). See above.

b. What are the characteristics of these cameras? (Including field of vision, resolution, scan rates, etc.) A: See above.

c. How will these cameras function in comparison to human visual capabilities from the cockpit perspective (on the UA)? A: Assuming this question wants information comparing human vision to the described camera vision with respect to FOV, resolution, scan rates, attention span, etc. – this comparative information is not known.

d. Describe the display system and the presentation available to the pilot. A: Video is presented on a standard MQ-9 PSO color monitor to the pilot, with HUD symbology overlaid on it. Video source selection and amount of bandwidth reserved for the video is controlled by the pilot.

e. What are the interfaces and communications links between the camera and display system? A: Standard MQ-9 systems to acquire video, select video signals to transmit, multiplex signal(s), transmit signals, Portable Ground Data Terminals (PGDT's) for receiving signals, demux signals, and PSO workstation to display signals. There are physical (cable/connector) interfaces between the different components in the system. The RF signals can be transmitted via dual line-of-sight (LOS) C-band links (in analog or digital

formats) or a single over-the-horizon (OTH) commercial Ku band satellite link (in digital format). Video source selection and amount of bandwidth reserved for the video in the RF link is controlled by the pilot.

f. What is the reliability of the camera, display, and communications link being used by the pilot? A: Assuming this question wants specific and detailed information about the communications links like: MTBF, bit error rate (BER), how often the signals degrade – This information is not available.

17 .c Electronic detection systems

a. What types or models of electronic systems are being used to detect other airborne operations? (I.e. TCAS, Capstone, etc.) A: Relying on FAA radars in all airspace types in conjunction with the aircraft's on-board TSO certified APX-119 IFF transponder (see above).
b. Are the electronic detection systems onboard the UA or remote? A: FAA detection systems (see above).
c. What are the capabilities of each electronic detection system? (I.e. transponder equipped aircraft, non-transponder equipped aircraft, terrain and/or obstructions, etc.) A: Aircraft has TSO certified transponder (see above).
d. What is the reliability of each electronic detection system? A: Unknown.
e. What information will electronic detection systems provide to the pilot? (I.e. potential aircraft conflicts, terrain conflicts, etc.) A: ATC will provide appropriate information to the pilot based on airspace class and ATC workload.
f. Will electronic detection systems trigger an autonomous action by the aircraft? With command link? A: No. Without command link? A: No.
g. If the electronic detection system provides potential conflict information to the pilot, what are the performance standards of the system? A: N/A.

17.d Visiual (sic) Observation by Ground Observers

a. What are the skills, knowledge, and certifications of each ground observer to detect other airborne operations? (I.e. Familiarity with FARs, AT operations and procedures, etc.) A: Visual observers not required since aircraft will be in Class A airspace for the entire mission. Aircraft will be in R-2508 SUA when below FL180.
b. How will each ground observer detect other airborne operations in comparison to human visual capabilities from the cockpit perspective (on the UA)? A: N/A (see above).
c. What are the lateral and vertical range limits that ground observers will be employed? A: N/A (see above).
d. What are the communications capabilities between each ground observer and UA pilot? A: N/A (see above).
e. How many aircraft will each ground observer be responsible to monitor? A: N/A (see above).
f. Will any ground observer also pilot the aircraft? A: N/A (see above).

g. What is the legal connection between each ground observer and the proponent's organization? A: N/A (see above).

17.e Monitored by patrol/chase aircraft.

a. What are the communications capabilities between the patrol or chase aircraft and UA pilot? A: Chase aircraft observers not required since aircraft will be in Class A airspace for the entire mission. Aircraft will be in R-2508 SUA when below FL180.

b. Will the pilot of the patrol or chase aircraft also be responsible for observing the UA and providing deconfliction information to the UA pilot? A: N/A (se above).

c. What are the skills, knowledge, and certifications of the airborne observer to detect other airborne operations? A: N/A (se above).

d. How will the patrol or chase aircraft detect other airborne operations in comparison to human visual capabilities from the cockpit perspective (on the UA)? A: N/A (se above).

e. Will the patrol or chase aircraft be treated as a "formation flight" with the UA by ATC? (I.e. MARSA, etc.) A: N/A (se above).

f. Will the airborne observer maintain visual observation with the UA at all times? A: N/A (se above).

g. How many aircraft will the patrol or chase aircraft observer be responsible for monitoring? A: N/A (se above).

h. Will the airborne observer also pilot the UA? A: N/A (se above).

i. What is the legal connection between the patrol or chase aircraft and the proponent's organization? A: N/A (se above).