NATIONAL RECONNAISSANCE OFFICE (NRO)

MEMORANDUM FOR NOTRE DAME SENIOR AEROSPACE ENGINEERS

FROM: The Office of Dr. Thomas Juliano, Lead Reconnaissance Aircraft Design Officer, University of Notre Dame

SUBJECT: Observation Without Loudness (OWL)

Attention:

We seek a novel yet reliable reconnaissance aircraft for the monitoring of potential threats to national security. This document outlines the basic requirements and mission objectives for your prototype, remote-controlled design.

Aircraft design requirements: This design proposal calls for a single aircraft capable of rapid climbs and long-duration unpowered glides. Visual images should be captured during the glide phase of missions. We are looking for a responsive system with a high rate of climb and notable glide characteristics to maximize surveillance mission radius. As there is no need for enhanced maneuverability or short takeoff distances, we are limiting the designs to fixed-wing aircraft, as opposed to vertical take-off and landing (VTOL) vehicles. Other general requirements for the prototypes include:

1. Must take off from the ground --- no hand launching.
2. Your power plant for the aircraft will be supplied by NRO, and the same components will be provided to all design teams: an electric motor, a propeller, and a battery pack, along with control electronics (servos, receivers, GPS, etc.). The aircraft can be designed to fly with either a pusher or puller type propulsion system.
3. Care should be taken when designing the internal volume of the aircraft. The following items must be accommodated:
   a) Motor speed controller and battery pack,
   b) the radio control receiver and receiver battery,
   c) all the servos required for vehicle control (maximum 9),
   d) and the micro-controller and GPS used for the acquisition of flight information.
4. A landing system capable of safely returning aircraft in both powered or unpowered conditions.
5. Importantly, the aircraft must be capable of supporting the supplied sideways-facing observation camera and its mount. This will be discussed further in the Payload section.

Aircraft safety requirements: The primary concern is safety, both in designing and building the aircraft and in their flight performance. For this reason, your aircraft must have/pass the following safety considerations to be considered for evaluation:

1. An easily accessible arming fuse securely mounted to the outside of the aircraft. This fuse will keep the motor battery disengaged until ready for flight.
2. Wingtip markings that show the location of the CG (empty and with payload). These markings will allow for onsite determination of static stability of the aircraft.
3. Pass a Technical Inspection given by one of our contracted pilots as described further on the class website.

The payload: All teams will be given identical surveillance payloads, which consist of a working camera, its mount, and support equipment. It will operate independently of other aircraft systems. The viewing platform must have an unobstructed view of the survey area. The aircraft design must accommodate an undermounted camera mounting system that may face either port or starboard. The payload must have 4 inches of ground clearance during takeoff or landing. The payload must be removable, and the aircraft must be able to fly with and without it. Images from the payload will be useful to corroborate with data collected from internal aircraft systems.

Mission profile: The aircraft must start at rest at the take-off end of the runway. A 20 second countdown begins when the motor is throttled up. The aircraft will use this time to climb to the beginning of the unpowered flight. At the end of the countdown, the motor must be throttled to idle. A timer (counting up) will begin at power-down and time the duration of the gliding flight. There is no set course for the either the climb or glide phases. The craft must land intact to complete the task. Upon landing, the payload must remain secured in its original configuration.

Before attempting the payload mission, the aircraft will be flown empty, without payload, to test flight characteristics and performance.

System evaluation: The metric for system success will be:

$$S = \frac{1}{2}(t_1 + t_2) \tag{1}$$

where S is the score and t_1 and t_2 are the best glide times recorded for loaded and unloaded configurations. The system with the highest score will be deemed the winner of the design challenge.

Mission logistics: To facilitate a timely evaluation the following practices will be observed. With the successful completion of the pre-flight inspection of the aircraft, the team will be allowed to

attempt the mission. A successful mission constitutes a landing without any significant damage to the aircraft, as determined solely at the discretion of the Flight Line Judge. Additionally, the payload must be safely secured upon landing and may not be contacting the ground. A non-successful landing will result in a non-score for that flight mission, and the mission must be reattempted. Once the two scoring missions have been flown successfully, the team will be allowed to attempt re-flights as time allows. Normal queuing procedures will be used. The flight queue will begin with the first team completing pre-flight inspection and will continue in order of completion of pre-flight inspections. The previous day's flight queue position will carry over to the following day if necessary. Teams will have a total of five minutes to load the payload and checkout the aircraft systems as fully functional with the pilots. There is no work allowed on the aircraft after the loading/checkout time or the team will forfeit their position in the queue. The RC receiver should be turned on externally or left on during this time. Any teams not able to complete staging in the allotted starting time will forfeit their flight position.

We sincerely look forward to the unique and exciting designs you have to offer. If you have any questions, please feel free to contact our staff.