IOWA STATE UNIVERSITY

MISSION APPROVAL

TEAM 1

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AERE 4610 Modern Design Methodology with Aerospace Applications

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Acronyms

AGL above ground level. *(p. 1)*

LiDAR light detection and ranging. *(p. 1)*

OPV optionally piloted vehicle. *(p. 1)*

RC remote-controlled. *(p. 1)*

SFF small form factor. *(p. 1)*

UAV unmanned aerial vehicle. *(p. 1)*

UAVs unmanned aerial vehicles. *(p. 1)*

1 Mission Overview

1.1 Customer Problem

On the busiest games, Jack Trice Stadium can hold 61 500 people, and protecting these people is the highest priority of the Iowa State University Police Department (Stadium, 2024). Quadcopters and unmanned aerial vehicles (UAVs) increasingly pose a threat to large gatherings and events as their violent use is popularized in armed conflicts such as the Russian-Ukrainian conflict (Thompson, 2024). To protect against these threats, organizations like the Iowa State University Police Department and similar defensive organizations need tools to neutralize the threat posed by a terrorist or bad actor armed with a weaponized UAV.

Traditional anti-aircraft systems are designed to target larger objects like airplanes or large UAVs and are generally ineffective against small targets such as the DJI Mavic 3 Pro quadcopter (DJI, 2024). Additionally, the shrapnel and debris field produced by the explosives commonly found in traditional anti-aircraft systems are unsafe for civilian use at stadiums or event centers.

Products like Anduril's Anvil—a defensive quadcopter—were created to fill this defense vacuum (Anduril, 2024). The Anvil disables enemy UAVs by smashing into them at high speeds. The Iowa State University Police Department is looking for a more cost-effective, optionally-attritable, optionally piloted vehicle (OPV) that can patrol a large area over the entire duration of an event; function without an expensive, permanent ground-based detection system; and destroy enemy quadcopters with kinetic energy.

1.2 Proposed Solution

An (optionally) remote-controlled (RC) aircraft that loiters at least 150 m above ground level (AGL). The aircraft should have enough battery to complete an hour long mission—multiple aircraft should be used simultaneously to ensure 100 % coverage of an event. The aircraft will be equipped with several sensors for detecting enemy UAVs, including but not limited to small form factor (SFF) radar or a light detection and ranging (LiDAR) sensor. The aircraft must be able to disable an enemy quadcopter—estimated

to be approximately 5 kJ, which would require a minimum velocity of approximately 45 m/s if the target were stationary—by ramming into it. The aircraft will also need to carry telemetry or communications equipment to communicate with a ground station.

2

Mission Profile

A draft of our mission profile is shown in Figure 2.1.

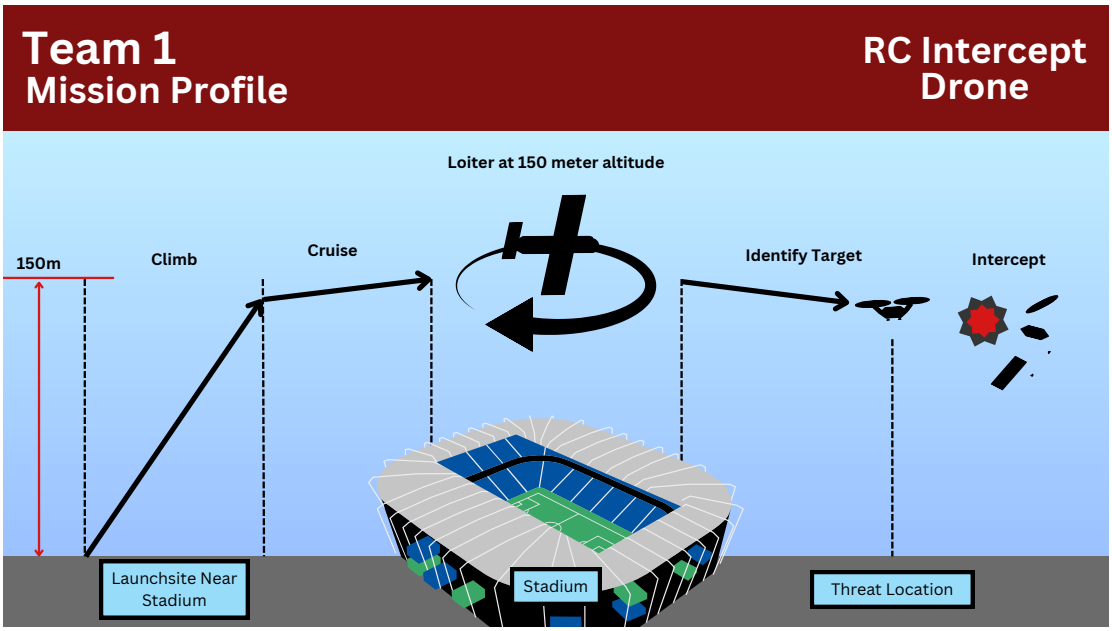

Figure 2.1: *AERE 4610 Team 1 mission profile.*