United States
Department of Energy
National Nuclear Security Administration
International Nuclear Security

Unmanned Aircraft Systems (UAS) and Counter-UAS Overview

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Outline

Mexican drug cartels are increasingly using drones to attack enemies and further their aims. These drones are from a seizure by the Attorney General of Mexico in Puebla in 2020. *Attorney General Of The Republic (Mexico)*

- Evolving UAS capabilities

- Risk Assessment: Evaluating impact of UAS threat

- Counter-UAS (CUAS) mitigation and limitations

- NNSA International Nuclear Security Support via UAS Team

UAS Capabilities

Technologies are evolving faster than our ability to keep up
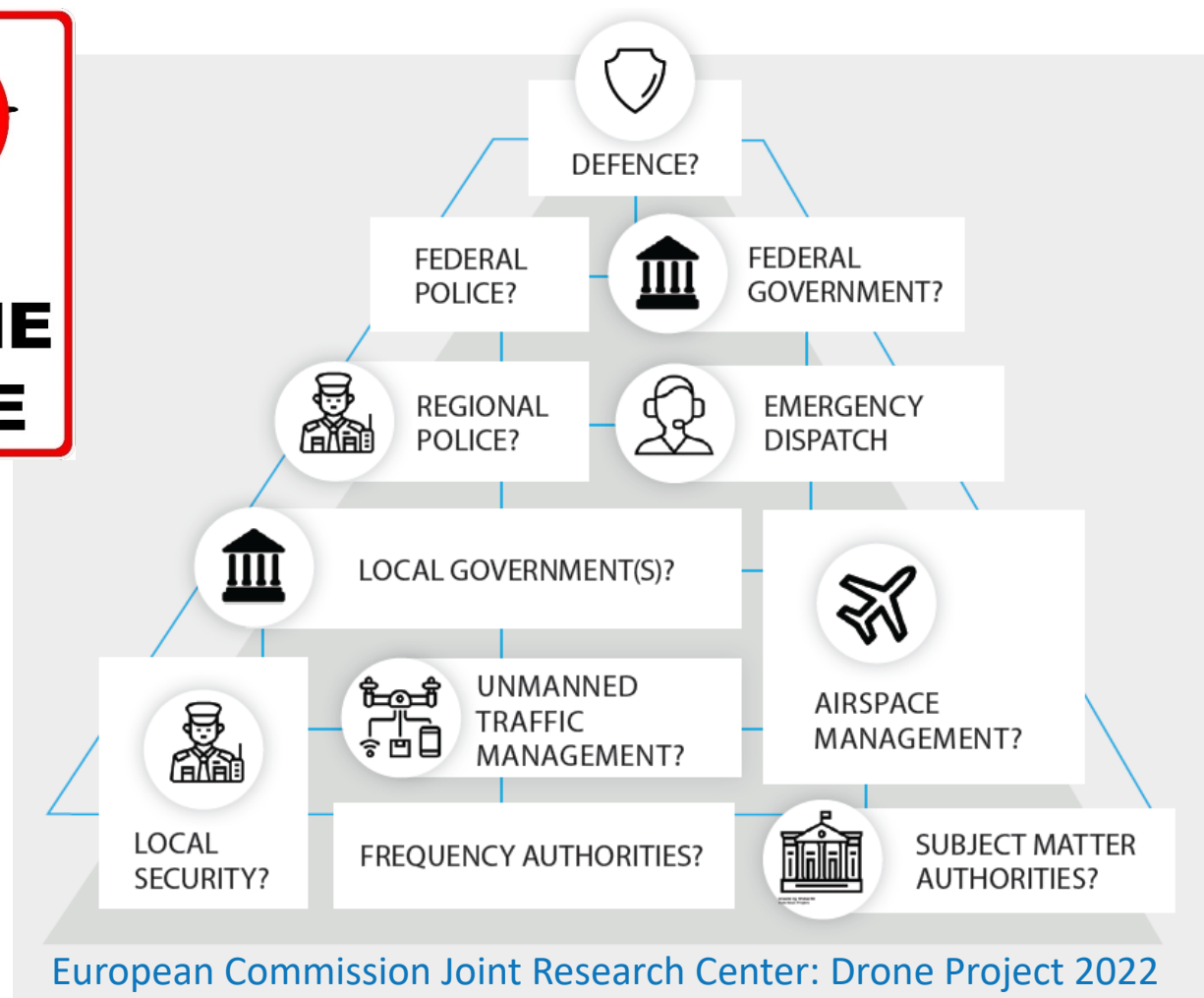
Extreme sports UAS lifting a person

Autonomous drone swarm

Advanced obstacle avoidance and human tracking

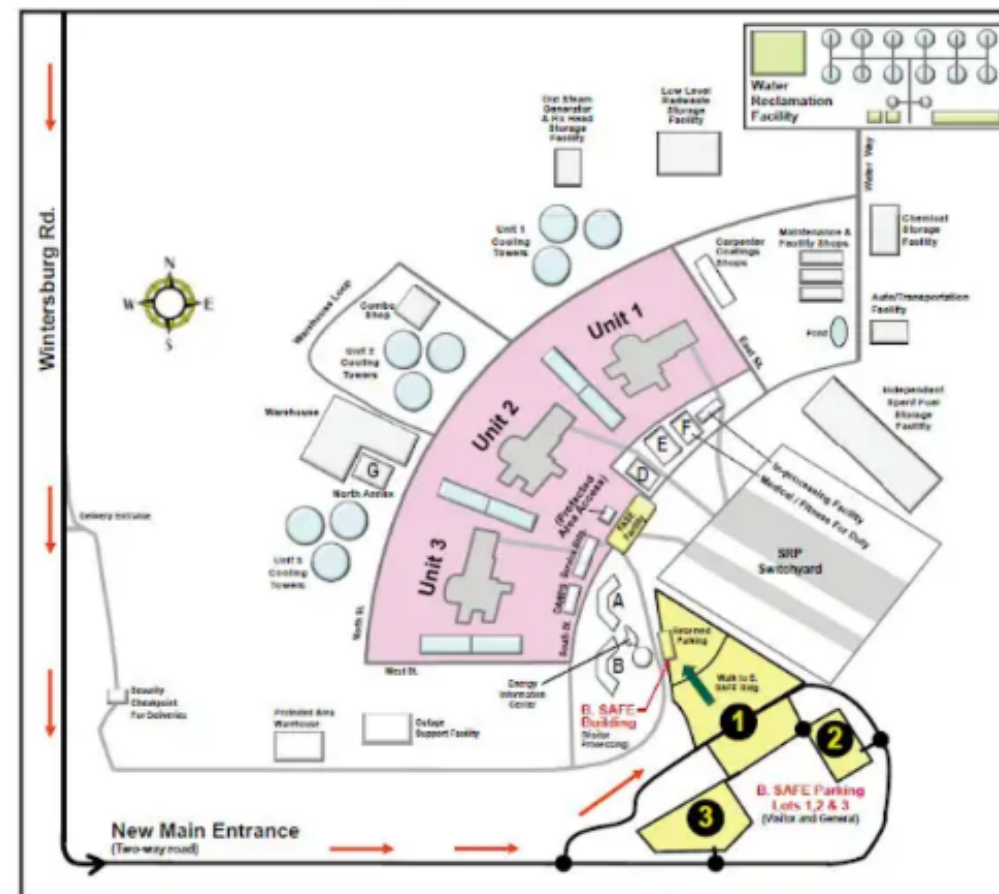Modified drone used to drop Molotov cocktail

Stakeholders in Counter-UAS Implementation at Critical Infrastructure

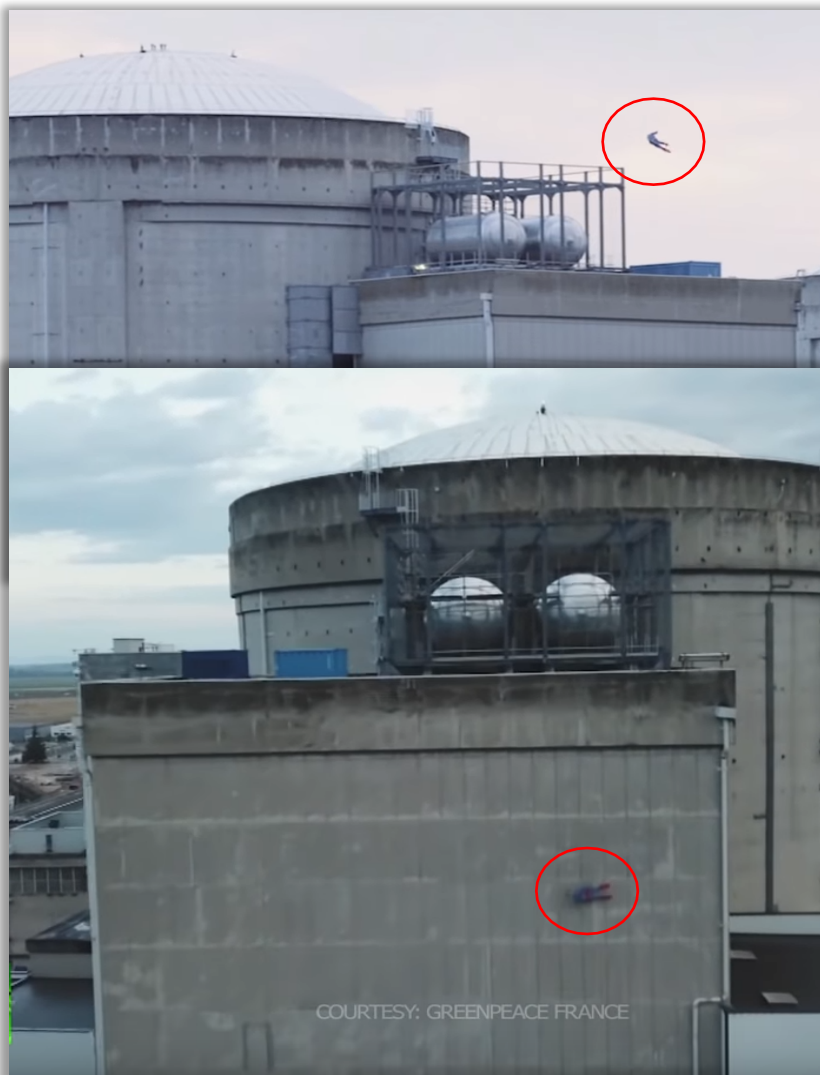European Commission Joint Research Center: Drone Project 2022

Palo Verde Nuclear Power Plant UAS Incursion

- Occurred on consecutive nights in September 2019

- Multiple UAS flew over and around a restricted area near the nuclear power plant

- NRC described the incident as a "drone-a-palooza;" said it highlighted concerns about the potential for a future "adversarial attack"

- This was not an isolated incident, has happened at +55 other nuclear facilities.

- NRC's Intelligence Liaison and Threat Assessment Branch (ILTAB) told site not to alert them of future drones since they could not do anything about it.

Simplified Site Layout

Greenpeace Superman Drone & Smoke Bomb Incidents

COURTESY: GREENPEACE FRANCE

Notional Example of UAS Security Risk Matrix:
UAS Impact According to Threat Group

Consequence Type	Risk Matrix Based on Threat Potential and Consequence Severity			
	Clueless, Careless (unintentional, accidental)	Activist/Protestor (intentional)	Criminal	Violent Extremist Organization (VEO)
Economic, Sociopolitical, Embarrassment	3	5	3	5
Facility Denial	2 / 3	4 / 5	3 / 4	5
Sabotage	1	4	2	4
Radiological Release	1	2 / 3	2	4

Risk levels designated from 1=Very Low (dark green) to 5 = High (red)

Counter-UAS (CUAS)

Technology or combination of technologies used to sense, assess, and mitigate a UAS

Sensing Technologies
- RF, Radar, Visual, Acoustic

Assessment Technologies
- RF, Visual

Mitigation Technologies
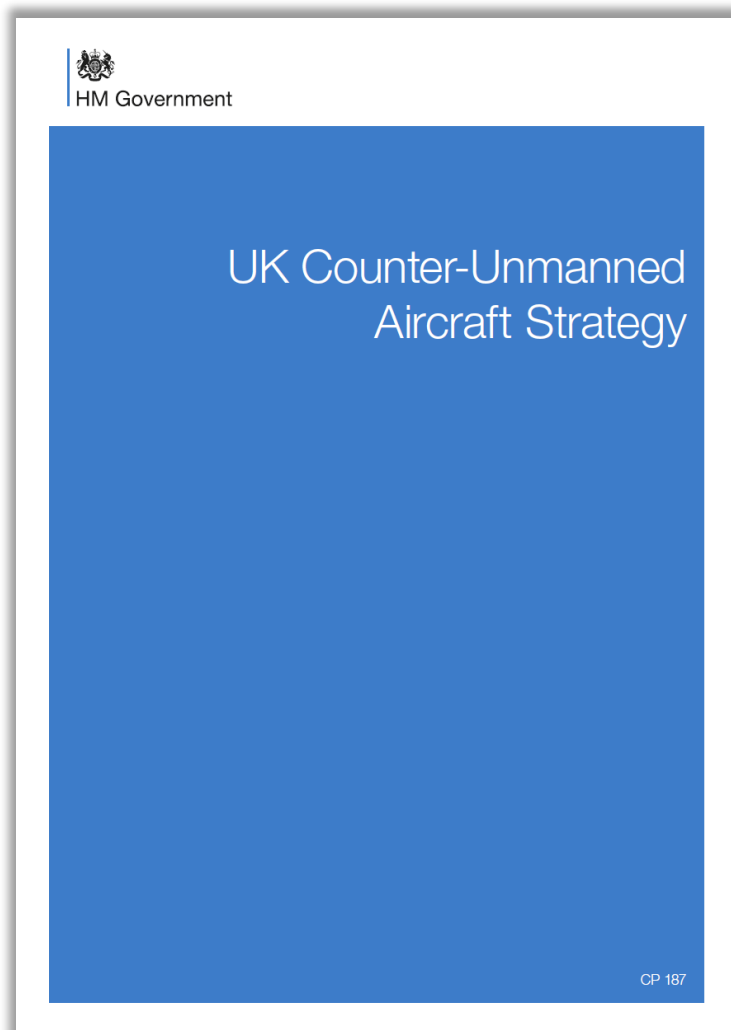- RF, Ballistic Projectile, Net Capture, Directed Energy

(1)

(2)

(3)

(4)

Gatwick Airport UAS Incursion – December 2018

- Gatwick Vulnerability Analysis was done in Dec 2017
- Drone response plan developed; practiced a response exercise
- Posted signage
- RF sense-only systems installed on airport roof
  - " Designed to view and relay telemetry data sent by command and control link from DJI-brand drones (most popular brand), making drone data accessible to the end-user.

NO DRONE ZONE

Federal Aviation Administration

Lessons Learned from Gatwick Experience

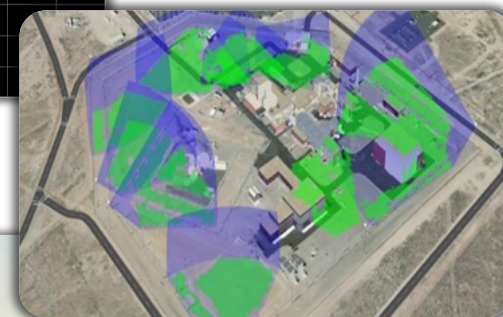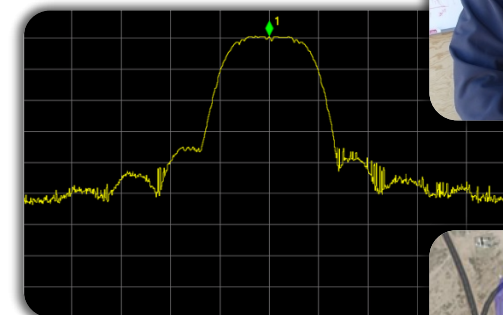UK Counter-Unmanned
Aircraft Strategy

HM Government

CP 187

- Need adequate detection and mitigation solutions

- Test and prove the efficacy of these solutions

- Use a blended system

- Conducting target controls of outer areas

- Need for continuous vulnerability assessments

- Review the response plan

- Increase police involvement, education, understanding, training, and coordination

- Understand that policy lags pace of technology

NNSA International Nuclear Security (INS) UAS Team Support

Goal: Work with the international nuclear security community to understand the threat and mitigation of unmanned aircraft system (UAS) incursions on nuclear facilities and materials in transit.

- Combine multi-laboratory UAS and CUAS experience, expertise, and resources

- Conduct targeted studies, evaluations, collaborations, and testing to address key needs and questions impacting the nuclear security community

- Develop awareness and tools or methods to assess risks and solutions

- Explore the use of UAS to enhance nuclear security

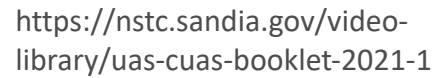- Conduct technical engagements and build ongoing relationships

Questions we are trying to address

- How do you assess the risk of a UAS event or incorporate UAS threats into security planning, and where do you start?

- **What are some credible adversary uses of technology and its impact on nuclear security assessments?**

- **What are the recent trends and developments in UAS technologies and how might these impact risk**?

- What are the operational and performance realities of handheld jammers and other CUAS equipment when responding to a UAS event?

- What are the considerations, benefits, and limitations of using UAS for security operations at nuclear sites?
    - " Tethered and untethered deployable systems
    - " Inspection, surveillance, safety

- **Where can nuclear facility operators and national police get recurring, hands-on familiarization and training on a variety of UAS and CUAS technologies to inform policy, CONOPS, security planning, and acquisition**?

- What are the collective global lessons learned and best practices?

Engagement/Briefing Material

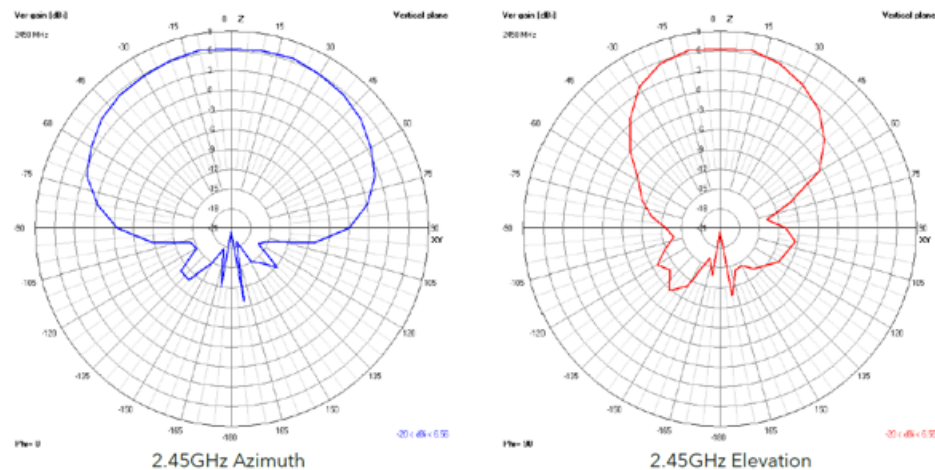| Title	Description
2021 UAS/CUAS Trends and Developments	Booklet includes recent developments in platforms, payloads and sensors, cyber resilience, autonomy, police and response use of UAS/CUAS, and state-sponsored activities.
Anatomy of a Drone	Overview of UAS components along with the 'what and how' of CUAS mitigation techniques affect each part of the drone's anatomy.
Blue Force/Response Use of Unmanned Aircraft Systems (UAS)	Deep dive into application and operational considerations that Blue Force/Pro Force need to know when thinking about using UAS supplement security and/or response capabilities.
Common CUAS Technologies Strengths and Weaknesses of	Explanation of CUAS technologies along with pros/cons
CUAS Metric Calculation Tool	Application tool to provide standardized criteria and easy comparative method for peers and other countries that plan to evaluate CUAS, the data from which is key to decisions on effectiveness for the intended application/site conditions but can be daunting.
CUAS Testing and Evaluation Lessons Learned	CUAS selection can be overwhelming due to rapid technology advances and slow regulation development; system testing key to understanding actual operational efficacy.
Current UAS Technologies	Overview of UAS technologies and trends and the potential physical security concerns.
Down-Selection of CUAS for Testing and Evaluation	Selection of CUAS can be complicated due to rapid technology advances; outlines the process/thinking needed to refine selection of appropriate CUAS and then verification of operational parameters with testing.
Examples NNSA Laboratory-Directed Research and Development (R&D)	Current R&D efforts related to CUAS. This is typically used for mature or peer countries to foster partnership/collaboration.
Implementing CUAS at a Nuclear Facility	Strategies, best practice, and lessons learned based on Los Alamos National Laboratory's experience when evaluating and integrating CUAS at their facility.
Integrating Law Enforcement into CUAS Conduct of Operations	U.S. DOE implementation experience and lessons learned when integrating a CUAS; coordination with law enforcement.
Interactive UAS Security Workshop	Can be presented virtually or live. Goal is to help partners work through the complex interactions between physical protection, response, and UAS technologies during drone incursion. Workshop consists of several scenarios that involve UAS to identify potential regulatory/legal complications, communication/coordination touch points, and possible physical security and response strategies to help mitigate UAS impact.

Title	Description
Responding to a Downed Drone	Process and operational considerations when responding to a downed drone
Testing and Evaluation of Commercial Off the Shelf Handheld Radio Frequency Jammers	Technical assessment of several COTS handheld UAS jammers to determine the operational realities of using these devices to mitigate drones.
Testing and Evaluation of Commercial Off the Shelf Tethered UAS to Supplement Physical Security	Technical assessment of several tethered-UAS (TUAS) to aide informed acquisition/deployment decisions by providing partners with observed performance aspects in an operational environment.
Scribe 3D Scenarios (click link to view): • **Basic Fly In and Surveillance** • **Multiple Drones/Diversion** • **ProForce Use of CUAS** • **ProForce Use of UAS in PPS**	Short, animated video scenarios to convey concepts and foster discussion.
UAS Awareness Roll Call Video	Professional short video to capitalize on pro-force's shift orientation time and message awareness of threats. The intent is to showcase pro-force/law enforcement explaining UAS capabilities and emerging concerns as well as best practice/lessons learned strategies to help them deal with the threat and amp up awareness.
UAS Risk Assessment Process	Overview of risk assessment approach considering UAS as an adversary tool and the need to look at credible attack scenarios and/or site-/area-specific capabilities.
US Drone Regulations & Policy Overview	Overview of US regulation and policy from NRC and FAA perspectives; gaps and future developments.
Video Demos (click link to view): 1) **Skydio Autonomous Tracking** 2) **UAS Surveillance at 90 meters** 3) **Tethered-UAS Test** 4) **UAS vs Ground Response Assessment** 5) **RF Jammer Deployment**	1) Shows how UAS can be used to track human movement within a facility. 2) Recording of video surveillance of a facility taken by a UAS flying at 90 meters. 3) Demonstrates capabilities of a tethered UAS for facility security. 4) Compares timeline of ground response versus UAS response to a facility intrusion alarm. 5) Use cases for several different commercial-off-the-shelf handheld RF jammers used to stop rouge drones

UAS and CUAS Trends and Developments

https://nstc.sandia.gov/video-library/uas-cuas-booklet-2021-1

Evaluation of Commercial Handheld RF Jammers

2.45GHz (C2 Band 1)

2.45GHz Azimuth

2.45GHz Elevation

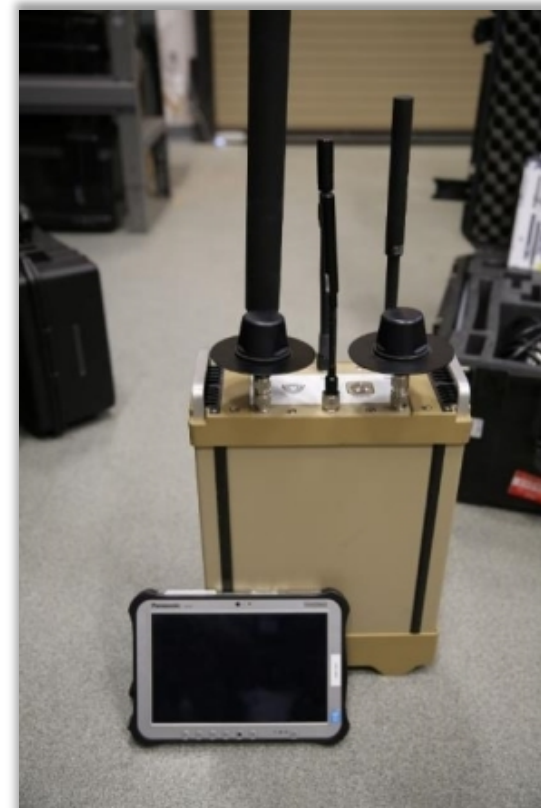# Evaluation of Commercial Tethered UAS

Inventory of Tested Drone Detection and Mitigation Technologies

Aeroscope – RF detection for DJI drones

Squarehead Acoustic Detection

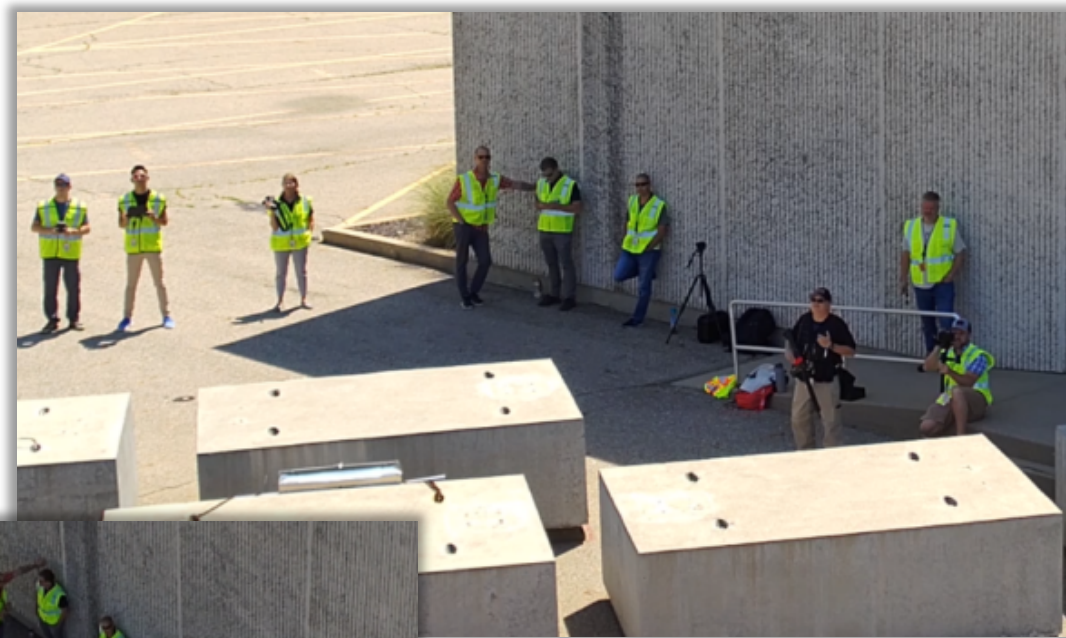

Titan – RF detection for DJI + other drones

Test Net Capture Systems

Model DYI Drones and Deployment Techniques
to Test Against CUAS Equipment and Evaluate Threat Capability

UAS Awareness 'Roll Call' Video for Response/Site Security