Blue Unmanned Aircraft Systems for First Responders

Focus Group Report

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The "Blue Unmanned Aircraft Systems (UAS) for First Responders Focus Group Report" was prepared by the National Urban Security Technology Laboratory—in conjunction with DAGER Technology, LLC—for the U.S. Department of Homeland Security, Science and Technology Directorate pursuant to contract 70RSAT18CB0000049/P00006.

FOREWORD

The National Urban Security Technology Laboratory (NUSTL) is a federal laboratory within the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T). Located in New York City, NUSTL is the only national laboratory focused exclusively on supporting the capabilities of federal, state, local, tribal, and territorial responders to address the homeland security mission. The laboratory assists responders with the use of technology to prevent, protect against, mitigate, respond to, and recover from homeland security threats and incidents. NUSTL provides expertise on a wide range of subject areas, including chemical, biological, radiological, nuclear, and explosive detection, personal protective equipment, and tools for emergency response and recovery.

NUSTL manages the System Assessment and Validation for Emergency Responders (SAVER) program, which provides information on commercially available equipment to assist response organizations in equipment selection and procurement. SAVER knowledge products provide information on equipment that falls under the categories listed in the DHS Authorized Equipment List (AEL), focusing primarily on two main questions for the responder community: "What equipment is available?" and "How does it perform?" The SAVER program works with responders to conduct objective, practitioner-relevant, operationally oriented assessments and validations of commercially available emergency response equipment. Having the right tools provides a safer work environment for responders and a safer community for those they serve.

NUSTL is responsible for all SAVER activities, including selecting and prioritizing program topics, developing SAVER knowledge products, and coordinating with other organizations to leverage appropriate subject matter expertise. In conjunction with DAGER Technology, LLC, NUSTL conducted a focus group on commercially available Blue Unmanned Aerial Systems (UAS). This equipment falls under the AEL reference number 03OE-07-SUAS titled "System, Small Unmanned Aircraft."

SAVER reports are available at www.dhs.gov/science-and-technology/saver-documents-library.

Visit the NUSTL website at www.dhs.gov/science-and-technology/national-urban-security-technology-laboratory or contact the lab at NUSTL@hq.dhs.gov.

U.S. Department of Homeland Security

SAVER

System Assessment and Validation for Emergency Responders

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EXECUTIVE SUMMARY

Emergency responders use unmanned aerial systems (UAS) in support of public safety activities such as search and rescue, firefighting, and post incident reconstruction. UAS provide first responders with an aerial view of their environment and can be outfitted with various sensors tailored to different applications. The publication of the "Blue UAS Cleared List" or "Blue List" by the U.S. Department of Defense's (DoD) Defense Innovation Unit may aid responder agencies with their acquisition processes. UAS on the Blue List or "Blue UAS" have been vetted to be compliant with DoD policy. Blue UAS fall under AEL reference number 03OE-07-SUAS titled "System, Small Unmanned Aircraft."

In November 2023, the S&T National Urban Security Technology Laboratory's (NUSTL) Systems Assessment and Validation for Emergency Responders (SAVER) program, with support from DAGER, convened focus groups, with representatives of the fire service and law enforcement community, of commercially available unmanned aircraft systems at NUSTL. The primary objective was gathering assessment criteria, possible evaluation scenarios, product suggestions and product selection specifications for future SAVER assessments. Across two days, six fire service members and seven law enforcement officers from various jurisdictions in Colorado, Florida, Illinois, Michigan, New Jersey, New York, Oklahoma, Oregon and Virginia, who have experience using or overseeing UAS activities, took part in the focus groups.

The focus groups identified 18 assessment criteria by which UAS should be assessed operationally. They considered Capability and Deployability the most important SAVER categories, and identified five criteria as being of utmost importance (listed alphabetically):

- Camera's Visual Acuity
- Flight Duration
- Command and Control Link Quality
- Latency
- Time to Redeploy

The focus groups recommended several systems and scenarios for NUSTL to consider for inclusion in the assessments, including a search and rescue operation, a post-incident damage assessment, a situational awareness exercise, and nighttime operations. NUSTL will use these recommendations to plan UAS assessments in rural and urban settings.

When considering UAS platforms, agencies should also consider impacts associated with integrating equipment into their power and information technology infrastructure, data management, cybersecurity, concept of operations, and required maintenance.

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1.0 INTRODUCTION

Over the past decade, first responders have begun integrating small unmanned aerial systems (UAS) as a resource for a variety of operational needs. UAS, often referred to as "drones," are used by first responders in support of public safety activities such as search and rescue, firefighting, and post incident reconstruction. UAS provide first responders with an aerial view of their environment and can be outfitted with various sensors tailored to address different applications. This equipment falls under the AEL reference number 03OE-07-SUAS titled "System, Small Unmanned Aircraft."

The publication of the "Blue UAS Cleared List" or "Blue List" by the U.S. Department of Defense (DoD) may aid responder agencies with their acquisition processes. The Blue List is a list of United States- and ally-manufactured UAS vetted by the Defense Innovation Unit (DIU) to be policy approved by the DoD. (Section 848 of the National Defense Authorization Act (NDAA) for Fiscal Year 2020 Endnote 2 prohibits the use of UAS or any related services or equipment from certain foreign entities.) All UAS on the Blue List are NDAA-compliant and have undergone cybersecurity testing by DIU or their contractors. Each device on the Blue UAS Cleared List is granted authority to operate (ATO) from the DIU.

In November 2023, the S&T National Urban Security Technology Laboratory's (NUSTL) System Assessment and Validation for Emergency Responders (SAVER) program, with support from DAGER Technology, LLC (DAGER), conducted focus groups with representatives of the fire service and law enforcement community on commercially available UAS at NUSTL in New York, New York. NUSTL's primary objective of the focus group was to gather information on the participants' practical experiences relevant to operational and procurement decisions. This included gathering assessment criteria and product selection specifications as well as possible products and scenarios for future Blue UAS assessments.

1.1 Participant Information

Across two days, six fire service members and seven law enforcement officers from various jurisdictions, each with at least two years of experience flying UAS, participated in the focus groups. Their professional information is listed in Table 1-1.

Table 1-1 Focus Group Participant Professional Information

Participant	Years of Experience Piloting UAS	State
Law Enforcement	6	Colorado
Law Enforcement	6	Colorado
Fire Service	8	Florida
Fire Service	9	Florida
Fire Service	7	Illinois
Law Enforcement	8	Michigan
Law Enforcement	2	New Jersey
Law Enforcement	7	New Jersey
Fire Service	7	New York
Fire Service	9	Oklahoma
Law Enforcement	4	Oregon
Law Enforcement	9	Virginia
Fire Service	4	Virginia

2.0 FOCUS GROUP METHODOLOGY

The focus group opened with an overview of NUSTL, the SAVER program, Blue List UAS, and goals and objectives of the focus group. Once that background material was covered, a NUSTL facilitator led focus group discussions on four sets of recommendations:

1. Assessment criteria: product features that are important to consider when making operational or procurement decisions.
2. Assessment scenarios: operational settings and activities that reflect responders' experiences and would provide evaluators with appropriate conditions to assess the products.
3. Product selection criteria: features, attributes or characteristics a product should possess to be considered for assessment.
4. Products: specific brands or models that are relevant to the emergency responder community and should be candidates for inclusion in the comparative assessment

Figure 2-1 illustrates the process for gathering these recommendations.

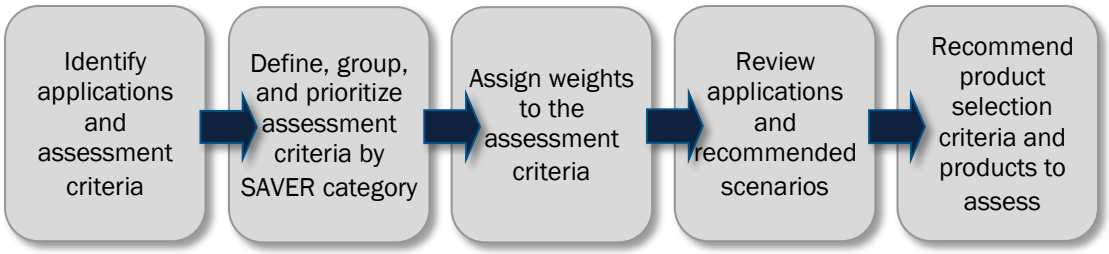

Figure 2-1 Focus Group Process

Focus group participants first identified applications in which UAS are commonly used. Next, the focus group participants identified and defined assessment criteria, which were then grouped within the SAVER categories: affordability, capability, deployability, maintainability and usability. The SAVER categories organize criteria in the following manner:

- **Affordability** groups criteria related to the total cost of ownership over the life of the product. This includes purchase price, training costs, warranty costs, recurring costs and maintenance costs. Criteria categorized under Affordability may be discussed at the SAVER assessment but will not be used to score products.
- **Capability** groups criteria related to product features or functions needed to perform responder-relevant tasks.
- **Deployability** groups criteria related to preparing to use the product, including transport, setup, training, and operational or deployment restrictions.
- **Maintainability** groups criteria related to the routine maintenance, storage, calibration, and minor repairs to be performed by responders, as well as any included warranty's terms, duration, and coverage.
- **Usability** groups criteria related to ergonomics and the relative ease of use when performing responder-relevant tasks.

Once the assessment criteria were sorted into the SAVER categories, focus group participants deliberated and assigned a weight for each criterion's level of importance on a 1 to 5 scale, where 5 signifies critical importance and 1 – minor importance. (See Table 2-1 for additional explanation.) The group of responders then reviewed and refined the criteria and respective weights.

Table 2-1 Assessment Criteria Weighting Scale

Weight	Definition
5	This evaluation criterion is ***of utmost importance: "I would never*** consider purchasing a product that does not meet my expectations of this criterion or does not have this feature."
4	This evaluation criterion is ***very important***: "***I would be hesitant*** to purchase a product that does not meet my expectations of this criterion or does not have this feature."
3	This evaluation criterion is ***important***: "Meeting my expectations of this criterion or having this feature ***would strongly influence*** my decision to purchase this product."
2	This evaluation criterion is ***somewhat important:*** "Meeting my expectations of this criterion or having this feature ***would influence*** my decision to purchase this product."
1	This evaluation criterion is ***of minor importance***: "Other things being equal, meeting my expectations of this criterion or having this feature ***may influence*** my decision to purchase this product."

The focus group participants then identified product selection criteria for inclusion in SAVER's assessment of Blue List UAS. They reviewed the applications identified at the beginning of the focus group session and recommended operational scenarios for the assessment. Lastly, the participants discussed requirements for an assessment venue in light of those scenarios.

3.0 ASSESSMENT CRITERIA RECOMMENDATIONS

The focus group identified 18 assessment criteria to assess operationally and concluded that Capability was the most important SAVER category, followed by Usability, Deployability, and Maintainability respectively. No criteria for Affordability were identified because of the known costs of procuring Blue List UAS. Table 3-1 presents assessment criteria and their weights by category. Participants also identified 38 product specifications of interest, which will not be assessed operationally, that are captured in Appendix A.

Table 3-1 Assessment Criteria

SAVER CATEGORIES			
Capability	**Deployability**	**Usability**	**Maintainability**
Camera's Visual Acuity Weight: 5	Time to Redeploy Weight: 5	Ease of Use Weight: 4	In-House Maintenance Weight: 3
Flight Duration Weight: 5	Deployability Weight: 4	Ground Control Station (GCS) Interface Weight: 4	
Command and Control Link Quality Weight: 5	Portability Weight:4	GCS Legibility Weight:4	
Latency Weight: 5		Customizable Safety Features Weight: 3	
Automated Mapping Weight: 4		External Spotlight Weight: 3	
Automated Flight Modes Weight: 2		Covertness Weight: 2	
		Operability of GCS with Gloves Weight: 2	
		Hot Swappable GCS Battery Weight: 1	

3.1 Capability

Capability refers to product features or functions needed to perform responder relevant tasks. The focus group identified and defined six capability criteria. They are listed below in descending order of importance, as ranked by the focus group.

Camera's Visual Acuity refers to the subjective clarity of the image produced by the camera.

Flight Duration refers to the approximate time of flight considered suitable for a first responder's operational needs based on varied conditions (perching, weather, such as wind).

Command and Control Link Quality refers to the reliability of the radiofrequency data link between the ground control station and the UAS. This includes the ability to stream live video from the UAS, and share the feed, through complex environments with minimal interference.

Latency refers to the amount of time between the moment data is captured by the UAS and the moment it is received by the ground control station.

Automated Mapping refers to the capability of a UAS to be programmed to execute a mapping mission with parameters provided by the operator.

Automated Flight Modes refers to non-manual capabilities, such as an orbit or position hold, that assist the operator during flight.

3.2 Deployability

Deployability refers to preparing to use the product, including transport, set up, training, and operational/deployment restrictions. The focus group identified and defined three deployability criteria. They are listed below in descending order of importance, as ranked by the focus group.

Time to Redeploy refers to the amount of time it takes to change the UAS battery (or batteries) and return to flight.

Deployability refers to the ease of and the amount of time it takes to remove the UAS from its case in addition to its boot up and configuration time prior to take off.

Portability refers to the ease with which the UAS can be transported from one location to another. This includes the size, weight and shape of the carrying case(s).

3.3 Usability

Usability refers to criteria related to ergonomics and the relative ease of use when performing responder relevant tasks. The focus group identified and defined eight usability criteria. They are listed below in descending order of importance, as ranked by the focus group.

Ease of Use refers to the intuitiveness of setting up and deploying and operating the UAS.

GCS Interface refers to the ease of use of the GCS, including the intuitiveness and human factors integration of the graphical user interface (GUI), configuration adjustments, menu navigation, control buttons, joystick, etc.

GCS Legibility refers to the visibility of the screen in various lighting conditions, considering Nit of brightness[1] and if it's backlit.

[1] A unit of measurement that refers to the amount of light emitted from an object.

Customizable Safety Features refer to the ability to manually override safety features, such as "hover," "land" and "return to home," in order to achieve mission goals.

Covertness refers to the amount of light and sound being emitted by the UAS during flight.

External Spotlight refers to the ability to carry and the ease of using a light source during low- or no-light operations.

Operability of GCS with Gloves refers to the ease with which the GCS can be used while wearing gloves.

Hot Swappable GCS Battery refers to the ability to change the battery for the GCS without losing power.

3.4 Maintainability

Maintainability refers to the routine maintenance, storage, calibration, and minor repairs performed by responders, as well as included warranty terms, duration, and coverage. The focus group identified and defined one maintainability criterion. They are listed below in descending order of importance, as ranked by the focus group.

In-House Maintenance refers to inspections and component replacements (e.g., propellers, landing gear) that can be performed by technicians, without specialized tools and within the user's agency or department, rather than having to be returned to the vendor for maintenance.

4.0 ASSESSMENT SCENARIO RECOMMENDATIONS

The focus group participants identified search and rescue, post-incident damage assessment, situational awareness, and night operations as the primary use cases for Blue List UAS. Based on these applications, the focus group participants recommended four scenarios, as described in sections 4.1–4.4, in which products could be assessed using the assessment criteria in Table 3-1. The assessments will also include a familiarization session.

To represent operations in differing geographical areas, NUSTL is planning two assessments: one in a rural setting and a second in an urban environment. All of the suggested scenarios may not be executed in both geographical settings. The SAVER assessment team will plan scenarios based on venue suitability and environmental conditions. Required venue features include a conference room as well as varied infrastructure (e.g., buildings made of concrete, metal, or a combination of the two), a rubble pile, a wooded area, a water element (e.g., a swift water training facility or stream), and the option to conduct testing in the darkness, all of which were identified by the focus group as necessities for operationally assessing UAS outdoors.

4.1 Search and Rescue

Evaluators will participate in a planned search and rescue (SAR) operation in daylight conditions in a rural environment to locate individuals that are hiding (i.e., manhunt) and others wanting to be located (i.e., lost hikers). Evaluators will use a UAS—using both manual and automated flight modes—to search for the individuals in a designated area. The evaluators will control the UAS from pre-selected areas with varying levels of sunlight and sun cover on the GCS. Evaluators may encounter deciduous and coniferous forested areas, open fields, roads and trails, ponds and lakes, various natural terrain features, vehicles, and various structures (i.e., cabins or houses). The evaluators will attempt to locate the individuals; disseminate video; and provide an accurate location and other information regarding the individuals (e.g., physical condition, direction of travel, weapons, clothing) to incident command.

Assessment criteria scored during this scenario will include Automated Flight Modes, Camera's Visual Acuity, Command and Control Link Quality, Deployability, Ease of Use, Flight Duration, GUI for GCS, GCS Visibility in Different Lighting, and Latency.

4.2 Post Incident Damage Assessment

In daylight conditions, evaluators will conduct a damage assessment during a disaster relief operation. Evaluators will fly a UAS over a designated area and encounter simulated smoke, victims, vehicles, debris and rubble piles (comprised of a variety of materials such as wood, metal, stone or brick), various types of terrain (wooded areas, fields, bodies of water) and simulated spills and gas leaks (i.e., "hot" and/or "cold" spots). Evaluators will inspect infrastructure for damage. They will also conduct two-dimensional mapping of the area and attempt to locate and share accurate location information for any simulated victims, the best ground routes into the area, and any hazards to follow-on ground units.

Assessment criteria scored during this scenario will include Automated Mapping, Automated Flight Modes, Camera's Visual Acuity, Command and Control Link Quality, Customizable Safety Features, Ease of Use, Flight Duration, External Spotlight, GCS Interface, GCS Legibility, and Latency.

4.3 Situational Awareness

Evaluators will respond to a simulated unplanned daytime incident requiring the rapid deployment of a UAS to gather and provide detailed intelligence and situational awareness to responding public safety personnel. During the scenario, the evaluators will set up and fly each UAS from its stored configuration (i.e., from the manufacturer-supplied storage case in a vehicle). Evaluators will then collect and share UAS imagery to conduct remote triage, assess a hostage situation in a parking area with multiple vehicles, identify hazardous materials labels, assess a structure for hot spots and/or assess a suspicious package. The evaluators will use the UAS to identify items such as firearms or license plates from various distances and locations in differing lighting conditions (i.e., shaded/unshaded). They will also be required to land the UAS and change the GCS and UAS battery or batteries halfway through of the scenario then redeploy to continue gathering information.

Assessment criteria scored during this scenario will include Automated Flight Modes, Camera's Visual Acuity, Command and Control Link Quality, Deployability, Ease of Use, GCS Interface, GCS Legibility, Hot Swappable GCS Battery, Latency, Portability, and Time to Redeploy.

4.4 Night Operations

Evaluators will participate in a planned SAR operation in a rural environment during the evening (i.e., low light conditions) to locate individuals that are hiding (i.e., manhunt) and others wanting to be located (i.e., lost hikers). Evaluators will don gloves to assess the usability the GCS with gloved hands[2] as they use the UAS to search a designated area using both manual and intelligent flight modes. The evaluators may encounter deciduous and coniferous forested areas, open fields, roads and trails, ponds and lakes, various natural terrain features and various structures (e.g., cabins, houses). They will attempt to locate the individuals; disseminate video; provide an accurate location and other information (e.g., physical condition, direction of travel, weapons, clothing) regarding the individuals to incident command.

Assessment criteria scored during this scenario will include Automated Flight Modes, Camera's Visual Acuity, Command and Control Link Quality, Covertness, Customizable Safety Features, Ease of Use, External Spotlight, Flight Duration, GCS Interface, GCS Legibility, Latency, and Operability of GCS with Gloves.

4.5 Other Considerations

After the last scenario for each UAS platform, the evaluators will conduct the manufacturers' prescribed routine maintenance. Each evaluator will also change one propeller using the system toolkit in order to assess the In-House Maintenance criterion.

[2] If the UAS is not "flyable" with gloves, evaluators will document that finding and continue the Night Operations scenario without gloves.

5.0 PRODUCT SELECTION RECOMMENDATIONS

The focus group participants identified five product selection criteria that may be used to select products for the Blue List UAS assessment. Table 5-1 presents and explains those criteria. NUSTL will use these criteria to select UAS from the Blue List based on factors such as cost, availability, and subject matter expert recommendations.

Table 5-1 Product Selection Criteria

Product Selection Criteria	Description
Battery Power	Responders wanted UAS that work on rechargeable batteries.
Single-Person Deployable	Responders noted the UAS should be easily deployable by one person.
Vertical Take-off/Landing (VTOL)	Responders required a UAS with VTOL capability.
Electro Optical and Infrared (EO/IR) Sensors	The UAS should have an EO/IR payload that is part of the approved Blue List package.
Live Video Feed	The UAS must have a real-time feed from the cameras viewable on the GCS.

The focus group participants recommended selecting the following products for inclusion in the assessment, all of which are actively on the Blue List at the time of the focus group:

- Ascent AeroSystems, Spirit UAS
- FlightWave Aerospace Systems Corporation, Edge 130
- Freefly Systems, Freefly Systems Astro
- Inspired Flight, IF800 TOMCAT
- Parrot Drones, PARROT ANAFI USA GOV
- Skydio, Skydio X2[3]
- Teal Drones Inc., Teal 2

[3] The Skydio X10 is in the process of being added to the Blue List and may replace the X2. If the X10 is added during the planning process, it will be assessed.

6.0 SUMMARY

The focus groups were conducted over the course of two days, consisting of six fire service members and seven law enforcement officers, respectively. Each participant had at least two years of experience piloting UAS. The focus groups identified 18 assessment criteria by which UAS should be assessed operationally. Of the SAVER categories for criteria, Capability and Deployability were the most important. Participants also identified five operational criteria as being of utmost importance (listed alphabetically):

- Camera's Visual Acuity
- Command and Control Link Quality
- Flight Duration
- Latency
- Time to Redeploy

The focus group participants recommended several scenarios and products to consider for inclusion in the upcoming assessment. These recommendations will be used to plan two SAVER Blue List UAS assessments, one in a rural and the other in an urban environment.

7.0 FUTURE ACTIONS

The focus groups' recommendations will be used to guide the development of the Blue List UAS assessment plans, as well as the selection of products to evaluate in the assessments. Once the assessments are complete, the results will be published to the SAVER website at www.dhs.gov/science-and-technology/saver/blue-uas-first-responders.

8.0 ACKNOWLEDGEMENTS

NUSTL thanks the focus group participants for their valuable time and expertise. Their insights and recommendations will guide the planning and execution of the assessment as well as future SAVER projects. The lab also extends its appreciation to the departments, including Boulder Police (Colorado), City of Miami Fire Rescue (Florida), Clackamas County Sheriff's Office (Oregon), DoD's Defense Innovation Unit, Germantown Hills Fire Department (Illinois), Michigan State Police, New Jersey State Police, New York City Fire Department, Norfolk Fire-Rescue (Virginia), Southern Manatee Fire & Rescue (Florida), Tulsa Fire Department (Oklahoma), and Virginia State Police for allowing these first responders to participate in the SAVER program.

Additionally, NUSTL would like to thank the Denver Fire Department (Colorado), Las Vegas Fire & Department (Nevada), the Los Angeles County Fire Department (California), and the New York City Police Department for providing valuable insight on UAS operations.

APPENDIX A. SPECIFICATIONS OF INTEREST

Application Programming Interfaces (API) refers to the ability for a UAS to share data and use programs like DroneSense, AirData or Android Team Awareness Kit (ATAK).

Availability refers to the ability of the manufacturer to produce and deliver UAS within a specified timeframe.

Battery Charge Time refers to the amount of time it takes to recharge a battery from 0% to 100%.

Battery Life refers to the manufacturer-identified duration that a battery (or batteries) will maintain a UAS flight for a given payload weight.

Customer Support refers to resources and technical support provided by manufacturers, including software updates, a loaner policy, time required for repairs, subscription-based services, manuals, reference materials, and hours of availability.

External Storage refers to a removeable data storage device on the UAS and/or GCS.

Frame Rate refers to the number of images captured per second of video (frames per second).

HDMI Output refers to the ability of a UAS ground control station to share audio and video information through a wired HDMI cable connection.

In-house Maintenance refers to inspections and component replacements that can be performed by individuals within the user's agency or department, rather than having to be returned to the vendor or taken to an approved service provider for maintenance.

Ingress Protection Rating refers to the resistance of an enclosure against the intrusion of dust and liquid.

Interoperability and Integration with Other Platforms refers to the in-built API within a UAS designed to share data and video with third-party software systems.

Maintenance Timeframe refers to the turnaround time for repairs or maintenance when the UAS is returned to the manufacturer.

Multi-Port Charger refers to whether a system offers a device designed to connect to and charge multiple batteries, either in sequence or simultaneously.

Multiple Controller Capability refers to the ability to operate a single UAS from multiple GCS.

Network Connectivity of GCS refers to the ability of the GCS to connect to the internet (e.g., Wi-Fi, Cellular, SATCOM) to allow information sharing .

Open Source refers to whether the UAS runs on software that's licensing arrangement allows for unlimited distribution and use of its source code.

Operating Temperature refers to the temperature range in which the manufacturer has tested their UAS for safe operation.

Orientation Indicators refers to visual markers to assist users in understanding the position and direction of the UAS.

Payload refers to the weight a drone can carry outside of its own weight and/or extra cameras, sensors, or packages to be carried by the UAS.

Real-Time-Kinematic-GPS capability refers to the ability of a drone to accurately track its own location and geotag images captured during flight.

Reliability Testing refers to tests ensuring that a UAS has an acceptable level of safety and reliability when used by first responders.

Remote-ID-Compliant refers to compliance with the Federal Aviation Administration Rule that UAS broadcast remote identification information via radio frequency from takeoff to shut down.

Self-Heating Batteries refers to batteries being able to maintain their optimal temperature in cold conditions.

Sensor Redundancy (dual compasses or dual barometers) refers to backup components that can take over in case the primary ones fail during critical missions or in challenging environments.

Storage Temperature refers to the manufacturer's recommended UAS storage temperature.

Two-Way Communications refers to the ability to convey information back and forth between the pilot of the UAS and another party.

Warranty refers to the period of time and terms of coverage in which a vendor will replace or repair UAS equipment that is not functioning properly.

Wind Resistance Level (or Beaufort Scale Resistance) refers to a UAS's ability to operate without losing loss of control in a certain level of wind.