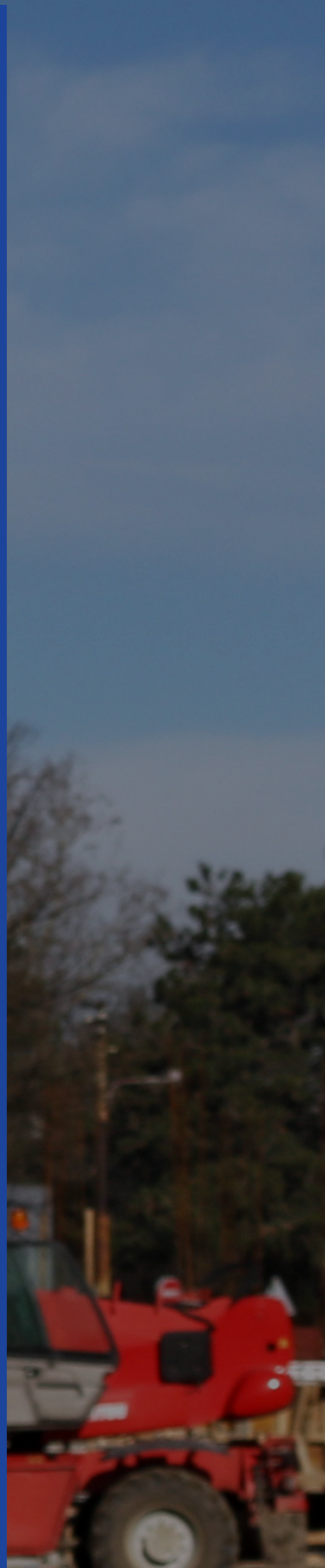
Construction Risk Engineering

Drones in Construction - Small Unmanned Aircraft Systems (sUAS)

CHUBB®



Contents

Introduction

Drone is a general term that dates back to WWII and has become the common name used among many when referring to unmanned, remotely controlled aircraft. The term dates to 1935, when U.S. Adm. William H. Standley along with British Prime Minister Winston Churchill observed a demonstration of a Royal Navy remote-control aircraft designed for target practice. This was a second generation aircraft named the DH82B Queen Bee. When William Standley retuned to the U.S., he put in change one of his Commanders to develop a similar aircraft for the U.S. The term Drone was adopted out of respect for the British Queen Bee, with a Drone being a type of Bee whose only purpose is to blindly serve the Queen.

Although generally referred to as a Drone, the defined terms for these unmanned remotely control aircraft are "Unmanned Aerial Vehicles" (UAVs), Small Unmanned Aircraft Systems (sUAS) or Unmanned Aircraft System (UAS). These are aircraft without a human pilot onboard; rather the UAS is controlled from a Remote Pilot on the ground[2]. Drones can be fixed wing or rotary, can be operated by a remote pilot, can be semi-autonomous or fully autonomous.

Construction is one of the fastest growing industries to utilize commercial sUAS in addition to industries such as agriculture, law enforcement and public safety. If adopted, they can provide a flexible and adaptable means to observe and manage a project through photograph and video as well as complete tasks where worker involvement can be avoided such as pest and weed control. Drones can provide a contractor with savings in time and cost as sUAS can be less expensive in the long run than the typical use of helicopters. sUAS can be purchased outright and used as often and on as many projects as needed or scheduled and rented with a Pilot to perform the work.

The adaptability of drones along with the evolving sophistication of software, cameras, video quality and applications, along with specialized equipment, can provide a diverse capability a contractor can utilize for a number of construction activities and needs.

Along with the many valuable capabilities provided to your construction and safety management processes, there are, in-tern, many hazards that also exist with operating drones. Operation by an unskilled Pilot, misuse, lack of maintaining the aircraft are just a few of the potential contributors that can lead to property damage, personal injury, loss of payload, loss of data collection, catastrophic loss due to striking commercial aircraft and loss of the aircraft itself.

Those who operate sUAS must take care and ensure that they are operated safely and in accordance with FAA regulations as well as within the manufacturer's recommendations for the aircraft's design and capability. The standard governing the use and operation of sUAS is 14 CFR Part 107 which took effect as of June 2016.

The following are examples of some of the practices that should be followed:

- Only Certified Pilots operate sUAS
- Pilots are in good health, not mentally or physically impaired and incapable of safely operating the sUAS (lack of sleep, illness, use of drugs or alcohol, use of certain prescription medications etc.)
- Pre-flight checks are completed before put into use for each flight
- Flown in potential inclement weather (high winds, icing, lightening, limited visibility such as fog) should be carefully evaluated to ensure the safety of the flight
- They are operated according to FAA requirements such as but not limited to; altitude, speed, visual line of sight, weight/cargo
- Are secured to prevent theft which can be used for unlawful activities such as terrorism or invasion of privacy

Incidents involving sUAS are becoming more common as their use continues to evolve and expand. Companies as well as the Pilots may be held liable if a sUAS is involved in third party property loss or bodily injury, collision with commercial aircraft or helicopters or if used to invade the personal privacy rights of others to name a few. If available on your sUAS platform, a contractor can chose to utilize technologies that allow the aircraft to detect and maneuver around obstructions during the flight such as other aircraft, structures, and power lines to limit potential loss.

Insurance carriers insuring companies who own and operate sUAS are becoming more knowledgeable and experienced in how they underwrite drone exposures. As drone use continues to expand, drone incidents along with case law will provide the insurance industry information needed to appropriately underwrite these risks.

As with any insurable exposure, how you control your insurance costs will depend greatly on how well you control the risk. Careful monitoring of your drone program and those who operate and maintain them is an important risk management function that should be established and incorporated into your overall risk management policies and procedures to protect against the potential exposures related to losses associated with their use.

There are many types and sizes of drones available today. They can range from small lightweight models used to carry camera equipment to larger "heavy lift" models that can be fitted with, for example, spraying tanks to be used for pest and weed control. For the purposes of this guide, we are focusing on what are known as Small Unmanned Aircraft Systems (sUAS). The term drone and sUAS are used interchangeably in this guide.

Licensing and Certification

The rules for non-hobbyist small unmanned aircraft (sUAS) operations are located in Part 107 of the Federal Aviation Regulations 14 CFR. This regulation covers commercial use of drones weighing 55 pounds or less at take off with payload.

The Federal Aviation Administration (FAA) requires all sUAS owners to register each drone that is purchased weighing between 0.55lbs to 55lbs. Those who meet the criteria to register an unmanned aircraft and do not register can be subject to civil and criminal penalties.[1]

The FAA Drone Registration Support Site has a list of known drones and whether they are required to be registered. This is not an all-inclusive list so if your drone is not on the list, but meets the requirements above, it may still need to be registered.

The FAA has specific rules for flying commercial drones; these are located in 14 CFR Part 107. Below is the Summary of the Major Provisions of Part 107 (Table 1) and includes but is not limited to:

- Registering your drone
- Obtain a Remote Pilot Certificate from the FAA
- Fly a drone 55 lbs. or less.
- Fly within visual-line-of-sight*
- Don't fly near other aircrafts or over people not directly participating in the operation, not under a covered structure, and not inside a covered stationary vehicle*
- Don't fly in controlled airspace near airports without FAA permission*
- Fly only during daylight or civil twilight, at or below 400 feet*
- Maximum groundspeed of 100 mph (87 knots)
- Maximum altitude of 400 feet above ground level (AGL) or, if higher than 400 feet AGL, remain within 400 feet of a structure.
- The Remote Pilot or Visual Observer may only operate One (1) sUAS at a time

** These rules are subject to an FAA waiver (Certificate of Waiver or Authorization (COA).*

To become a first-time pilot you must:

- Meet the minimum age requirement
- Be able to read, speak, write, and understand English (exceptions may be made if the person is unable to meet one of these requirements for a medical reason, such as hearing impairment)
- Be in a physical and mental condition to safely operate a small UAS

- Pass the initial aeronautical knowledge exam at an FAA-approved knowledge testing center
  - At this time there are no other testing/or practical exam requirements
- Valid for 2 years – certificate holders must pass a recurrent knowledge test every two years

Pilot Recertification Requirements
- Meet the minimum age requirement
- Certification must be easily accessible by the remote pilot during all UAS operations

The FAA Unmanned Aircraft Systems website provides all of the information necessary for registration, completing the applications to become a Pilot.[2]

The Remote Pilot and Visual Observer

Remote Pilot/Remote Pilot in Command
Being unmanned, the drone is operated by a Remote Pilot. The Remote Pilot and/or Remote Pilot in Command can be two different people or the same. The Remote Pilot can be the same person as the Remote Pilot in Command if he or she is the same person manipulating the flight controls of the small UAS. Any person operating a sUAS must either hold a Remote Pilot Airman Certificate with a small UAS rating or be under the direct supervision of a person who does hold a Remote Pilot Certificate (Remote Pilot in Command).

This Pilot is responsible for not only piloting the drone but the overall safety, security, privacy and conduct of the drone operations. The UAS must always remain within Visual Line of Sight (VLOS) of the remote pilot in command and the person manipulating the flight controls. The UAS must, at all times, remain close enough to the Remote Pilot in Command (RPIC) and the person manipulating the flight controls of the small UAS for those people to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses. This includes those drones that may be programmable as the FAA requires the RPIC to oversee all flight operations. Also in the event of an emergency, the RPIC must be able to take over manual flight control of the sUAS.

Because a sUAS has a Remote Pilot, the Remote Pilot does not have the same vantage point and ability to see the flight path or other obstacles such as manned aircraft that have a physical Pilot on Board. This is why the Remote Pilot must always be in Visual Line Of Sight of the drone in flight.

Where the sUAS is small and maneuverable, larger manned aircraft take longer to maneuver to avoid obstacles in the flight path and manned pilots have a harder time spotting the small UAS. Therefore when there is the potential for a collision between a sUAS and manned aircraft, the FAA requires the Remote Pilot of the sUAS to be the party responsible for yielding the right of way to other aircraft and taking the emergency action necessary to avoid a collision.

As part of the Remote Pilot responsibilities, the FAA requires a preflight inspection by the Remote Pilot in Command. The Pilot must also be capable of safely operating the sUAS. If he or she knows or has reason to know of any physical or mental condition that would interfere with the safe operation of a sUAS, it should not be operated. This includes any impairment from medications, drug or alcohol usage.

Due to the potential of accident and injury, the Remote Pilot in Command must report to the FAA any operation that results in at least serious injury, loss of consciousness, or property damage of at least $500.

This must be reported within 10 days of when the occurrence took place.

The Visual Observer
A Visual Observer position is created to assist the Remote Pilot in maintaining visual line of sight. The Visual Observer is defined as a person who assists the Remote Pilot in Command and the person manipulating the flight controls of the sUAS (if that person is not the Remote Pilot in Command) to see and avoid other air traffic or objects aloft or on the ground.

If a Visual Observer is used in the operation, then the Visual Observer would watch the sUAS instead of the Remote Pilot. However, if a Visual Observer is not used in the operation, then the operator has the responsibility to maintain his or her visual-line-of-sight with the sUAS. The Visual Observer and Remote Pilot must have effective communication and coordination at all times. This is by location; by being close enough for voice communication or by the use of communication-assisting devices such as radios.

There is no FAA Airman Certification or required training to be a Visual Observer.

Although there is no FAA requirement for the Visual Observer to be certified or complete any required training for this role, the remote pilot in command must, prior to flight, provide important information to the Visual Observer. This information includes but is not limited to:

- An understanding of the operating conditions
- Emergency procedures
- Contingency procedures

- Roles and responsibilities and
- Potential hazards.

The Remote Pilot in Command must also ensure that the Visual Observer understands and can properly utilize the determined method for maintaining effective communication with the remote pilot in command and the person manipulating the flight controls of the sUAS (if that person is not the Remote Pilot in Command).

Uses and Applications in the Construction Industry

Drone (sUAS) technology, photographic and video systems, 2D, 3D and Orthomosaic mapping, cloud storage, and other software and application advances are continually being developed and enhanced. The capabilities of drones to assist in the construction process and safety management are advancing rapidly and are expected to continue to become an ever growing and valuable asset for construction companies to utilize.

Some companies are still researching the potential use of drones within their organizations. Some are in their infancy stages with drones having purchased one or two or hired drones to assess their capabilities and others have embraced their use having purchased numerous drones and have larger numbers of certified pilots within their staff. Based on statistical information and studies in the US and abroad, drone use in many industries is expected to grow and become commonplace.

Drone capabilities and how they can be utilized by your company will depend on the level at which your company has embraced them and what is at your disposal. For example; having a single drone in your equipment inventory or renting the services of a drone as needed, can limit the amount of air time and locations that you can be expected to monitor; whereas owning several drones and having several Pilots, will allow you more flexibility. Having flexibility to call upon your drones when needed and in some cases, such as accident investigation, they may be needed within short periods of time, can be a powerful resource.

The following information will provide insight into the current uses of drones and how they can assist you in your project and safety management efforts. This can include: monitoring project conditions and progress; managing and coordinating contractors, supplementing and enhancing your Quality Control and Assurance programs, Accident Investigation and claims management; Safety and Health management, implementation and contractor oversight.

Site Planning and Inspection

- Drone use allows for investigation of project sites and conditions without the need to utilize additional workers. This can be especially helpful during the initial site investigation and planning phase where drones can take the place of workers needing access potentially dangerous locations and conditions due to landscape/terrane, flooding, extreme temperatures, dangerous animals, insects, foliage (snakes, rodents, insects, poison ivy/oak etc.)
  - It can also replace the need for workers to be placed in elevated locations such as roofs, towers and bridges; eliminating the potential for falls during inspections.
- Drone use allows for photos/videos in pre-planning efforts in assessing site emergency access, PPE requirements, appropriate tools and equipment needed and General Liability (GL) exposures such as a project's activities proximity to structures, roads, wetlands, and the general public.
- Management of laydown and delivery storage areas can become an important aspect of the project's coordination efforts. Initial determination of these locations may be efficient at the outset of a project but as the project grows and site conditions change such as delivery access and routes, installation of drainage or other structures the locations may need to be altered. The use of drones can provide high level, full-project observation photos and videos allowing you to see a complete picture of the available options and potential conflicts.
- Larger heavier lift capable drones, once used solely for agricultural applications are also being used in construction where pesticides and herbicides can be sprayed to control small pests as well as weed growth. These drones are equipped with a tank and spraying system that allows roadway or other site crews to apply the treatments without the need to exposure workers to the chemical sprays and potentially roadway traffic if managing highway maintenance. This can eliminate the need for specialized PPE and lane closures or restrictions.

Risk Management and Safety Compliance

Just as emerging technology and drones can assist you in project management and construction, the same can be said for Risk Management and Safety. The construction industry is benefitting in many ways with new technologies to provide more efficient means of completing exposure assessments, pre-planning, performing site audits, and determining PPE and other safety equipment as well as monitoring site conditions and worker safety compliance.

Drone camera and video along with software that can map and transpose topographical elevations and slopes can aid in monitoring excavation safety requirements, equipment placement and

safety, monitor fall protection practices and other worker safety requirements on your projects.

In addition, if utilized regularly, drone photos and video can aid in providing a comprehensive new hire orientation where workers can be shown a current overview of the project, access, egress and emergency muster points, areas designated off limits or access only with specific PPE as examples.

Monitoring Contractor Progress and Worker Productivity
Monitoring contractor and project progress can be a challenge, especially on large diverse and sprawling project sites. Being able to capture photo or video documentation on a regular basis can provide project management the benefit of viewing, sharing and displaying the information during routine progress meetings with affected contractors. This can provide clarity in discussions as well verification of project conditions and progress.

Monitoring worker productivity can benefit project management and safety in ensuring project workers are where they are supposed to be, addressing critical areas, as well as breaks and lunch. Drone use can be a tool when addressing any concerns or issues with a contractor's workforce as "a picture can be worth a thousand words". Photographic evidence of workers taking unauthorized breaks, longer than allowed lunches, smoking in designated "No Smoking" areas and even workers who may be using drugs or alcohol on the project.

There are a number of published articles outlining the potential liabilities of drone use as it expands. This can include exposures related to Privacy and Trespass; for example camera and video surveillance of workers. This is an area that is being evaluated as drone use becomes more prevalent and over time will likely be further defined through litigation and local, state and federal regulation.

If you intend to utilize Drones to monitor project workers, it is recommended that you first consult with your attorney to ensure that you are not violating any potential privacy rights, labor agreements or other state and local labor laws related to the subject.

Accident Prevention and Investigation
A critical aspect of any safety, health and risk management program is an established process for thorough accident investigation. A thorough and properly conducted accident investigation provides necessary information to properly establish root cause, identify and share lessons learned in preventing reoccurrence of the loss as well as provide detailed loss information to your insurance carrier. Accurate and documented loss information allows the insurance carrier's claim department to assess and efficiently manage the loss to its best possible outcome.

As noted above in the Risk Management and Safety Compliance section, drones can be utilized for accident prevention by being utilized as another set of eyes, viewing from vantage points not easily or readily seen from ground level. This can provide the safety department real time observations of site conditions and work practices in your efforts to control losses.

How can drones play a role before and after a loss has occurred?

- Drones enable a Safety and Risk Management department to obtain routine high resolution (3d/4k) photographs and videos of the project site. These progress photos can establish a timeline, showing progress and site conditions leading up to a reported loss or incident (to include near misses). Should an incident or loss occur, the drone can be called on to take post-incident project photos and video of the area where the incident occurred.
- These post-incident photos and/or video can play a key role in evidence collection by capturing site conditions around the time of the incident, equipment placement, work activity and worker locations, as well as weather conditions such as temperature, lighting and wind velocity.
- Progress and post-incident photo and video can aid the investigation process in determining what occurred, as well as prevention measures in your efforts to control future loss.

Project Security and Surveillance
Maintaining effective project security and surveillance is import in preventing unauthorized persons from entering the project site. Effective project security and surveillance will greatly reduce the opportunity for theft, vandalism, and fire.

Construction projects are known to be "attractive nuisances" and in areas with housing and schools nearby, an unprotected/unsecured construction site can be an inviting place for children and young adults to play, ride bicycles, and potentially climb on or into equipment, vehicles and dangerous locations within the site. In addition, during overnight hours and weekends where work is limited or inactive, there is the potential for homeless persons to enter the site for shelter.

Typically project security is achieved by chain link fencing with lockable gates and in some cases where more diligent efforts are needed, manned security personnel and/or video. Drones can be an effective means to supplement efforts by allowing project management to complete high level overhead observations where a full view of the project site along with thermal technology can locate gaps, damaged or unforeseen access points in the fencing, and identify unauthorized persons within a structure or around the site.

Inspection / (QA/QC)
Construction Defect (CD) prevention is an integral aspect of any construction project. A CD flaw or design mistake that reduces the value of the building or structure and/or causes a dangerous condition can be identified during the construction process; however, many are not as obvious and not identified until years later after the building or structure has been completed.

Depending on when CDs are first identified and how quickly they are corrected can affect a project and the company as a whole in many ways, including production, costs associated with the defect and subsequent repairs and the builder's reputation.

Currently, the typical use of drones in construction is to harness the capabilities available to enhance the quality control and assurance processes of a company and its project management staff.

- Drones with infrared/thermal technology can be used to photo/video exterior installations, roofing, solar panels etc. to detect potential water intrusion, and deficiencies or defects. Some Thermal technology cameras and software allow the contractor or inspection services to view in real-time without the need to first download/save to SD cards or use a computer's hard drive or upload to the internet. The real-time observations can be viewed, mapped and shared to the project team as the video is being captured.
- Overlay technologies allow the contractor to photo/video the structure or project site from above and apply overlays of the project to ensure accuracy
- Drone technology and accuracy of mapping is high with today's technology. Depending on the type of accuracy needed for your project; Relative "Local" or Absolute "Global", drone mapping capabilities can play a significant role in survey and project management.
- Drones with more advanced cameras and software have technology giving each pixel in the photo/video a 3 axis profile allowing for accurate topographical measurements. This provides accuracy and depth which can be used for comparing plans to site work, identifying deviations in the work, verifying grades, cuts, slopes, and site progress.

According to Drone Deploy; "High-resolution drone maps far surpass imagery gathered by satellite or manned aircraft in accuracy, accessibility, and cost." "Recent advancements in computer vision and machine learning help eliminate error and deliver automated roof measurements with up to 99% accuracy. And all of this is done up to 3x faster than traditional methods,"[5]

The use of Drones can, depending on the size of a project, take minutes to complete a task rather than hours in some cases if completed using conventional means.

The Future Use of Drones

As drones advance in capability, they have the potential to become larger and able to carry and lift materials and equipment. Research and development is already taking place with scale models to better understand how drones could be used in heavy lifting and placing structural members for construction as well as lift and place other equipment and systems.

Some companies have already begun to utilize drones in commercial commerce such as delivering purchased online products directly to the buyer's locations.

The FAA recognizes that the current regulations governing commercial use of drones will likely evolve and expand as they become more commonplace, complex and evolve in size and capability.

According to an online article published in thedrive.com on March 23, 2018, it stated that Acting Administrator of the FAA, Dan Elwell, stated at a Bloomberg Government conference earlier this month that the agency simply can't condone "unidentified objects" in its airspace. "We need assurances that any drone, any unmanned aircraft, operating in controlled airspace is identifiable and trackable," he said. "It's as simple as that."[6]

Currently registered drones are required by the FAA to have a drone identification number on them but it is not required to be on the exterior of the sUAS; it can be located in hidden areas such as behind a battery. The new FAA regulation will require the FAA identification number to be placed on the exterior of the sUAS and be "visible to an outside observer."[6]

Summary of Safe Operating Practices

As noted in the above guide, some of the known and potential risks of Drone use include but may not be limited to:

- Privacy invasion and trespass
- Property damage
- Bodily injury
- Collision with structures such as buildings, bridges, power lines etc.
- Collision with commercial aircraft
- Loss of proprietary data collected (imaging and environmental data)
- Loss of the Drone itself from impact (loss of battery power, loss of flight controls, improper use etc.)

To combat these risks, due diligence is necessary to ensure that each flight is planned, executed and completed without incident. Requirements and practices that should be followed include but are not limited to:

- Utilize only FAA Certified Pilots
- Follow all FAA requirements related to the operation of your Drone
- The Remote Pilot in Charge completes Operating Environment Assessment with includes but not limited to:
  - Review the flight path and obtain FAA waivers that may be required; includes local air space and flight restrictions, persons and property on the surface
  - Verify local weather conditions before and monitor them during the flight. If conditions are not favorable or change, creating safety concerns; reschedule or discontinue the flight
- Ensure the Drone is properly maintained to include but not limited to: pre-flight checks, battery life, airframe damage, required lighting, flight control systems (Control Station) properly functioning and load securement.
- The Remote Pilot in Command and others on the flight crew (as necessary) are mentally and physically capable of safely Piloting the Drone
- Always maintain proper line-of-site while in flight
- Pre-flight crew briefing completed to ensure the flight path, tasks/ objectives, communications and other required information is reviewed and understood by the crew
- Ensure state or local laws enacted to govern Drone use are understood and followed
- Utilize the Drone only for its intended business purpose. (not authorized for non-business use)
- Properly secure the Drone to prevent unauthorized use
- Be prepared for potential emergency situations and how to react such as evasive maneuvers to avoid collisions
- Notify your insurance Agent/Broker regarding your ownership of and/or use of Drones to verify that you have disclosed all the necessary information regarding the aircraft to your insurance carrier to ensure you have the appropriate insurance coverage for this exposure.

Conclusion

In today's evolving technology industries, advances are continuously being made in product development to include tools and equipment that can be applied to industry in efforts to make production cost efficient, increase quality, maximize output and provide a safer workplace.

This is no more evident than in the Construction Industry where advances in Drone technologies have provided numerous ways for Contractors and Owners to complete various tasks without the need for additional personnel and drawing upon the capabilities of hardware and software to maximize efficiency, productivity and quality in the building process.

With that said, much like with using any other piece of equipment, safety device or technology, there are also inherent risks involved that must be evaluated and understood along with appropriate processes, training and controls to be implemented to mitigate those risks.

References/Acknowledgements

1. https://federaldroneregistration.com/
2. https://www.faa.gov/uas/
3. Federal Aviation Administration – Final Rule - Operation and Certification of Small Unmanned Aircraft Systems
4. Federal Register 14 CFR Part 107
5. Drone Deploy – Drones for Aerial Inspection in Solar, Roofing and Insurance
6. http://www.thedrive.com/tech/21041/new-faa-regulation-requires-uav-owners-to-display-drone-id-on- exterior
7. FAA Advisory Circular – Small Unmanned Aircraft Systems, 6/21/16, AC No: 107-2

For additional information regarding these and other exposures, speak to your ESIS Risk Engineer about available Chubb Resource Guides and access to the Chubb Construction Risk Engineering Portal

For insurance policy coverage implications regarding drone use, please contact your insurance Broker or Chubb Underwriter.

Chubb. Insured.[SM]