CBIA 2018 Safety & Health Conference

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Drones & Safety: A Brave New World

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Outline

- Why CCSU PinnaclX and Eversource
- Eversource UAS Program History
  - OSHA Linemen Requirements
- UAS Benefits in the Utility Industry
- FAA, Data Management and Environment
- Selecting a UAS Operator or Becoming a UAS Operator for your Company
- UAS Applications

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Why CCSU-PinnaclX

In 2013 the FAA did not allow any UAS flight near power lines for any reasons. The FAA rejected all research and testing applications. The FAA would only consider applications from a state university with an established unmanned aircraft research program, the professor/operator must be a commercial pilot and be capable of operating unmanned aircraft.

- Alfred A. Gates Experience
  - Head of CCSU Department of Engineering UAS research program
    - Developed the UAS program at CCSU in 2006
  - RC aircraft pilot (hobbyist) since 1986
  - Fixed wing pilot
  - CFI/Commercial helicopter pilot

Eversource UAS Program History

Multirotor Unmanned Aircraft System for Transmission Structure Inspection

Massachusetts

Connecticut

New Hampshire

4,270 circuit miles of electric transmission lines, 72,000 pole miles of distribution lines, and 6,459 miles of natural gas pipeline in New England serving 3.6 million customers.

Approximately 54,000 transmission structures

EVERSOURCE Pinnacl

OSHA 1926.954 (b) (3) (iii) (c)

On and after April 1, 2015, qualified workers must use fall protection when climbing or changing location on poles, towers, or similar structures.

EVERSOURCE

Pinnacl

Eversource UAS Program Timeline

- **August 2013:** Partnered with CCSU to develop UAS program strategy
- **October 2013 – June 2014:** worked with the FAA to satisfy COA requirements
  - UAS Platform Tether Testing Next to High Voltage Power lines
  - Define Test Location, Operating Procedures, PIC, VO Requirements
- **June 2014:** CCSU awarded COA to research and develop Eversource's UAS program **(First COA in the U.S. for UAS flight in close proximity of energized lines)**

UAS Platform Tether Testing Next to 115KVHigh Voltage Power Lines Western MA Region

PinnaclX on line video:

- Purpose of video was to verify that EMF does not cause attitude control problems. The compass will be affected by the EMF
- https://www.youtube.com/watch?v=d8Ita9OKaKI

Results From Eversource and CCSU Research and Testing Effort

- **UAS is an additional tool to safely inspect infrastructure components.**
- **A UAS can:**
  - Perform detailed inspections like no other method
  - Improve worker safety
  - Improve public safety
  - Reduce infrastructure liability
  - Be used for preventive maintenance

Eversource UAS Program Timeline

- **March 2015:** Eversource partners with PinnaclX to develop a UAS inspection procedure for transmission towers and with in the wire environment.
- **June 2015:** FAA Grants PinnaclX a Section 333 Exemption.
- **August 2016– Present:** PinnaclX operating under Part 107. Safely inspected over 2130 structures and performs 3,900 UAS flights in the wire environment.

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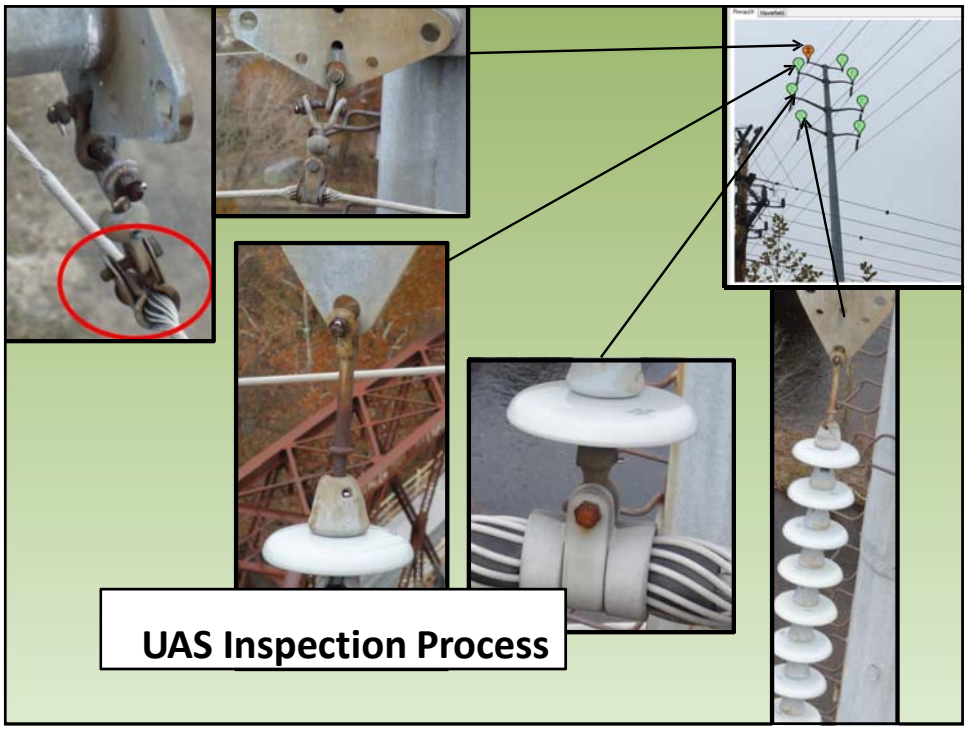
UAS Inspection Process

- The inspection process has changed from performing an inspection in the field to inspecting in an office setting.
- The UAS is used to collect photos, video data and thermal images.
- Problems have been over looked by in the field inspections compared with inspections being performed in the office.



UAS Benefits in the Utility Industry Improving Public and Worker Safety

- Substation inspection thermal imaging (Replacing helicopters and bucket truck to identify problems)
- Environmental (Checking for empty nest Osprey and Hawk)
- Tower and lines (Public safety and reduction in liability)

UAS Used for Worker Safety

- Elimination of the need to climb towers for inspection.
- Reduction in workers moving around hazards to identify problems.
- Identifies the hazards in an area that work needs to be performed.
- Reduces the time in a hazardous area by identifying the tools and materials needed to make a repair.

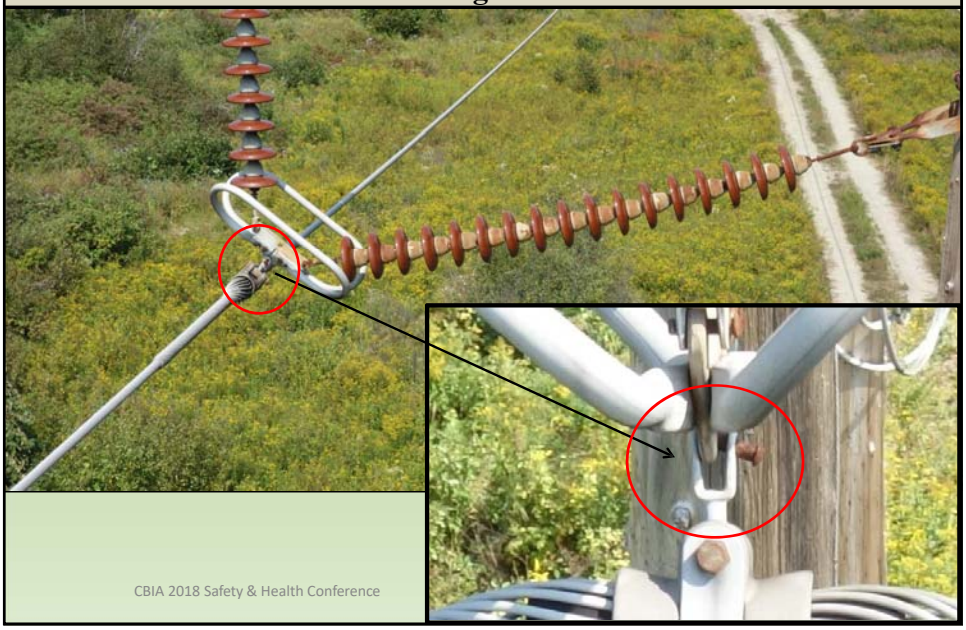
UAS Used for Public Safety

- Inspecting structures next to public areas (Highways, buildings transmission lines)
  - **Old methods 4000 pound helicopter**
  - **New method 4 pound UAS**
- Can perform detailed inspection quickly
- Identifies infrastructure hazards that other methods can not.

Examples of Public and Worker Safety

- Pins coming out of 345KV line crossing road in MA with a high traffic flow.
- Worn hook and plate on a 115KV line crossing a state highway and river.
- Melting of 345 KV switch in a substation.
- Environmental (mad bird on a structure that work was going to be performed on).

Public Safety 345KV Conductor Crossing Town Road with a High Traffic Flow



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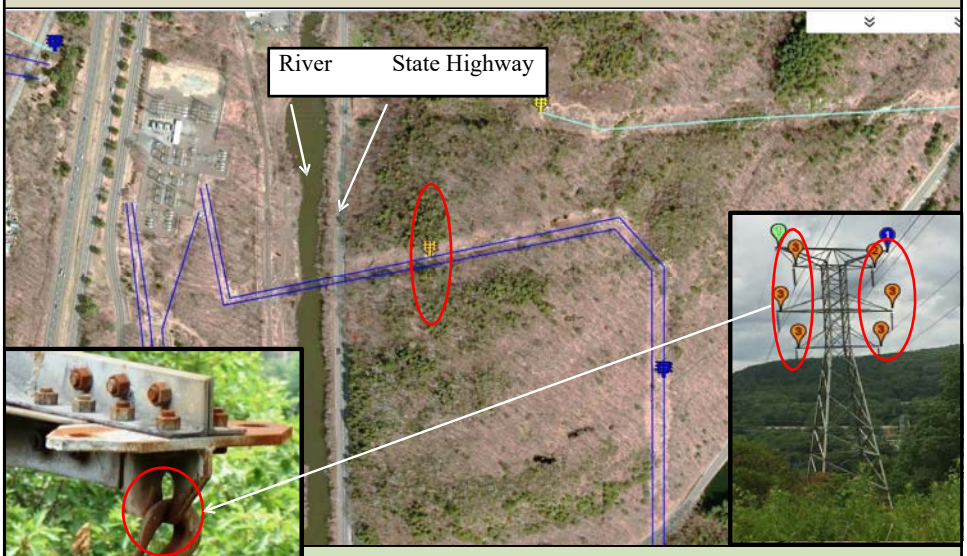
Public Safety 115KV Conductor Crossing a State Highway and River

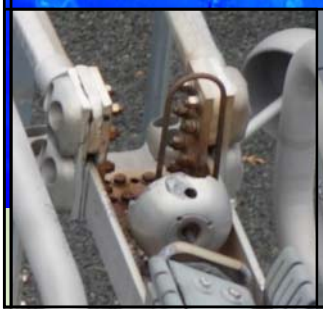


Cold End Conductors Cyclic Fatigue

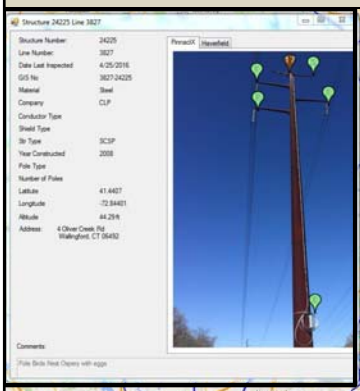
Worker Safety
UAS able to navigate around conductors in a substation

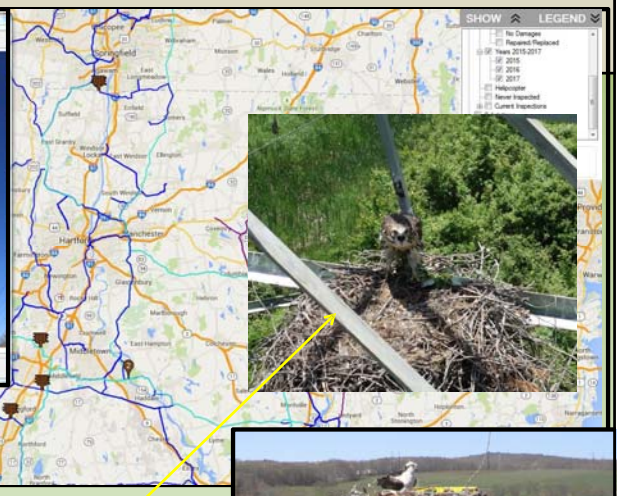
Ambient Temp: 32 F
SP1 Temp: 66.3 F
Temp rise: 34.3F

using a bucket truck or hiring a helicopter operator was being considered



Worker Safety Identifying Nesting On Structures





Mad Hawk on a structure

UAS Capability

An off the shelf UAS has the following capabilities
(Cost $1,000 to $2,000 dollars)

- Can fly for 3 miles (line of sight) from the remote pilot
  - FAA restricts distance to line of sight (you can see the UAS at ¼ mile)
- Can produce 4K video
- Can produce 20 MP photos
- Can stay in the air for over 30 minutes
- Provides a live video to a tablet connected to the controller
- Can fly back to the operator on its own (return to launch)
- Can stay at one location on it own (GPS hold)

DJI Phantom 3 and 4

Most popular UAS for recreational and commercial operations

FAA, Data Management, Environment

Challenges Using UAS: FAA Regulation's, Environment, Data Management

FAA Regulations: The aircraft must be registered, the pilot must be licensed and approved to fly at the location

Environment: The location where the operation is being performed (Hazards to the public, operator and aircraft): Can the remote pilot safely operate the unmanned aircraft at the inspection location. Wires, buildings, vegetation, and weather will contribute to the difficulty of flight.

Data Management: Currently we have over 70,000 high resolution photos, video and thermal images. How can you access them quickly

FAA Part 107 UAS Regulations 2018 Summary

Remote pilot: FAA Part 107 remote pilots license
(Warning this does not require UAS flight experience)

UAS operations with out any Part 107 Waivers

- Fly in class G airspace
- Fly up to 400 feet AGL
- Can fly at non controlled airports in class G airspace
  - Can not disrupt air traffic
  - Examples of a an airport in class G airspace Meriden and Roberson
- Can not fly over people moving cars etc.

Part 107 Wavers
Airspace: A Part 107 pilot can apply for waiver to fly near busy airports like Bradley and Boston Logan

Night Waivers: A Part 107 pilot can apply for waver to fly at night in class G airspace and in controlled airspace.

Beyond Line of Site: A Part 107 pilot can apply for waver to fly beyond the line of site of the remote pilot. Currently the FAA have granted a few of these waivers at remote locations for testing.

UAS Flight Environment

The remote pilot must be able to fly the UAS manually. Many Part 107 UAS operators only are capable of flying a UAS in a GPS position hold mode. Eventually a UAS will be flown to a location where the GPS signal and or compass fails.

Can the remote pilot operate the UAS in the proposed environment.

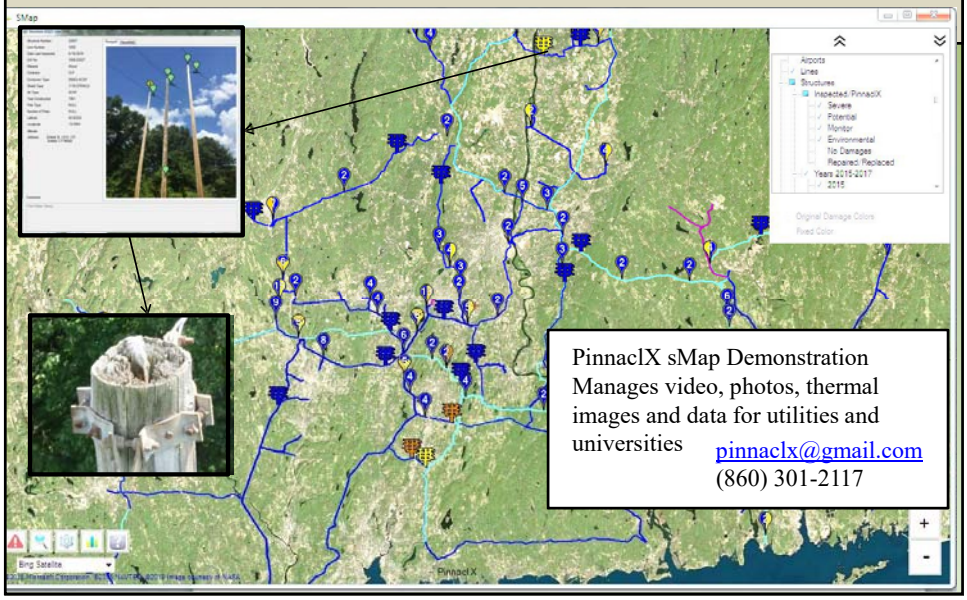
Example: Inspecting power lines will cause GPS an compass failure on a regular bases.

- Can the remote pilot operate the UAS if the winds pick up and blow the UAS down wind
  - Winds above tree tops around building and structures cause turbulence
  - Winds going in-between building or terrain cause an increase in wind velocity and up drafts that can out perform UAS

Play video at 7:59
https://www.youtube.com/watch?v=iDOg4D5VI8c

Data Management

(What do you do with 1000s of photos and hours of video)



Selecting or Performing UAS Commercial Operations for Your Company

- Part 107 Remote Pilots License Required
- Capable of flying a UAS in a manual mode in all orientations relative to you with obstacles
- Very familiar with the aircraft capabilities and limitations
- Has a operating procedure with a safety risk assessment process
- Has determined that your application can be conducted safely

Risk Associated With UAS Inspection

- Public safety
- Operation safety
- Safety of aircraft and equipment

- Select a UAS operator with actual experience not one that claims to have taken all kinds of online courses.

UAS Risk Reduction (Continuous improvement process)

- Site safety risk assessment
- Tailboard meeting
- Preflight inspection
- Follow operating procedure similar to manned aircraft, preflight inspection, inflight procedures and post flight inspection
- Post flight evaluation and modification to UAS Risk reduction plan

PinnaclX Transmission Tower Safety Risk Assessment

UAS Safety Risk Assessment:

(Both visual observer and remote pilot must agree to do an inspection flight)

Required if the UAS flight is next to a paved road with traffic or in a public area. Not required in remote open areas with low winds. Do not inspect structures that have line crews working on the structures

Remote Pilot_____Visual Observer_____Date:____

Line Number:_____ Structure Number:_____

Safety Risk Assessment (The sun is assumed to be behind the remote pilot during all phases of the flight)

Check the boxes that apply, add the score and make a decision to fly or not.

Traffic Type	Light	Medium	Heavy	Heavy Highway
	1	2	3	4
Winds	0 to 5MPH	5 to 10MPH	10 to 15MPH	15 to 20MPH
	0	2	3	4
Inspection Difficulty	Wood or steel H	Lattice or Steel Mono	Hybrid lattice	I have never seen this
	1	3	4	5
Structure Height	Under 50 feet	50 to 100 feet	100 to 150 feet	Over 150 feet
	0	2	4	5
Public Area	Parking Lot	Next to buildings on a side walk	Street interception on side walk	Side walk, street interception and distribution lines above
	1	3	5	5 or Do not fly unless there are no people
Non participating public	Within 200 feet	Within 100 feet	Within 50 feet	Within 25 feet
	1	2	4	5 or Do not fly unless people are informed and the remaining score is less than 4

UAS Safety Risk Assessment Score	

Score	Recommendations
0-10	Ok to fly
11-20	Fly with caution
21-25	Fly with extreme caution (do not fly if the winds are greater than 10mph)
Over 25	Cannot fly (report evaluation to PinnaclX)

UAS Applications

- **Line of sight inspections**
  - Power lines, pipe lines, rail roads
  - Power plants, oil rigs, ships, airplanes
  - Building, land
  - Bridged
  - Rail Roads
  - Wetlands environmental
  - Farm land
- **Line of sight night operations**
  - Storm damage assessment
- **Beyond line of sight testing at select locations**
  - Power line, rail roads, gas lines, search and rescue

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UAS New Applications

- **Building Maintenance**
  - Snow removal from roof tops
  - Evaluation of building after storms
  - Annual evaluation of building conditions
- **Assistance to Line Crews During Night Repair Operations**
  - Provide lighting
  - Provide video of storm damage