



## Applications for Unmanned Aerial Vehicles in Electric Utility Construction

### Applications for Unmanned Aerial Vehicles in Electric Utility Construction

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Education and 1 Contact Hour.**

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- Have your badge scanned at the door
- Attend 90% of this presentation
- Fill out the online evaluation for this session



## Research

- **Goal**
  - Outline the basis for electrical contractors to establish an Electric Utility UAV program
- **Methodology**
  - Research the current state of UAV capabilities
  - Review FAA policies for permitted uses, including performing elevated inspections of power lines
  - Visit an electric utility & contractor(s) to review their use of UAVs and potential future applications of UAVs
  - Develop templates for contractor safety and training, based upon FAA policies and utility/industry needs
  - Review other current/planned UAV uses in power line management
  - Establish best management practices to incorporate UAVs into an Electric Utility program
  - Determine minimal and optimal UAV platform capabilities, with recommendations



## Project Task Force

- Project Kick-Off Meeting Conducted on February 17<sup>th</sup>, prior to fully executed contract
- Task Force comprised of Utility Line Contractors, UAV Manufacturers, and other interested stakeholders

**Task Force Lead – O’Connell Electric**

Michael Parkes  
John Miller

**Greenlee**

Keith Moffatt  
Tracy Moyses  
Scott Hall  
Michael Moulin  
Joel Smith

**Utility Line Contractor Associations**

Jessica Halpin, Northeastern Line Constructors  
Bob Lalumiere, American Line Builders  
Western Line Constructors  
Missouri Valley/Southwestern Line Chapter

**Other Members**

Paul Goldsmith, Trimble  
Brett Bauz, Paradigm Sales Group  
Tim Speno, E2E Summit

**Textron Systems**

Dennis Racine  
Charlie Johnson  
Chris Ellsworth  
Steven Forrester



## UAVs Initially Reviewed

Brand	Model	Price	Type	Payload	Customizable Payload?	Ceiling Height (feet)	Flight Time (minutes)	Range (km)	Intended Use	Propulsion
3D Robotics	Solo (Enterprise Edition)	\$2,649	4 Rotor	Go Pro	Yes	300	20-25	0.6	Outdoor Surveillance / Filming	Electric
3DRobotics	X8+	\$2,000	8 Rotor (4 up / 4 down)	Gimbal and Camera	Yes	300	15	1	Outdoor Surveillance	Electric
Aertronics	Alura Zenith	\$32-42k+	4R Rotor	VIC, Multispectral, 10x optical Thermal IR Day Alt in one camera	Yes		30-35	1	Short Range Outdoor Surveillance	Electric
AeroVironment	Puma		Fixed Wing	customized payload, 360 degree continuous pan, +10 to -90 degrees tilt, stabilized EO, IR camera, and IR illuminator all in one modular payload.			3.5+ hrs	15	Outdoor / Maritime Surveillance	Electric
AeroVironment	Shrike		4 Rotor				40+	5kms (with communications rotor package)	Outdoor Surveillance	Electric
Aeyon	SkyRanger	~\$70,000	4 Rotor	Camera / Custom payloads		15000	50	35/16	Outdoor Surveillance / Mapping	Electric
Airbone Drones	Sentinel+	\$35-140k	4 Rotor	5kx, LIDAR, Thermal/4k dual, 80+ 100MP high resolution		15,000	74	35	Outdoor Surveillance	Electric
Alaska UAV	GeoMapper 1		Single Rotor / Helicopter	3.8 MP Quad Top, Sony Camera		8000	30-50		Outdoor Surveillance	Electric
Boeing / Intra	ScanEagle	\$3.2 million+	Fixed Wing	Electro-Optical Color Camera (25x optical zoom), IR/20x zoom stabilization		19,500	20+	100	Long Range Outdoor Surveillance	JP-8, JP-8, or gasoline
DJI	Inspire 1 (V2.0)	\$3000+	4 Rotor	360, 3 axis 4k Camera	No	15,000	18	5	Filming, Outdoor Surveillance	Electric
DJI	Inspire Pro	\$4000+	4 Rotor	360, 3 axis 4k Camera	Yes	15,000	15	5	Filming, Outdoor Surveillance	Electric
DJI	Matrice 100	\$3,300 + \$1000 (avroflight package)	4 Rotor	FLIR/DSLR	Yes		40	5	Outdoor Surveillance	Electric
DJI	Phantom 3	\$1,000	4 Rotor	3 axis 4k Camera	No	20,000	23	5	Filming, Outdoor Surveillance	Electric
DJI	Phantom 4	\$1,400	4 Rotor	4K Camera	No	19,200	28		Outdoor Surveillance	Electric
DJI	S1000	\$4000+	6 Rotor	DSLR Camera	Yes		15	1.7	Filming, Outdoor Surveillance	Electric
Flyability		<\$1000	4 Rotor	1080p video / 5mp stills			12	0.5	Indoor Surveillance	Electric
MarcusUAV	Zephyr2	\$14k+	Fixed Wing	1.3MP Multispectral		10,000	60	40	Long Range Outdoor Surveillance	Electric
Microdrones	md4-1000	\$55,000	4 Rotor	Camera, FLIR, Gas Detector, Multispectral camera	Yes	15,000	45/88	20 (using waypoints)	Outdoor Surveillance	Electric
Physical Sciences	Instant Eye (MOGen3)	Unknown / "Low Cost"	4 Rotor	3 differently angled cameras, FLIR camera		12,000	30	5-1.4	Outdoor Surveillance	Electric
Skycatch	EVO3		4 Rotor	12MP Camera			20+		Outdoor Surveillance	Electric
Textron	Aerosonde MK4.7	\$3.1 million+	Fixed Wing	Day/Night full motion vision, Multi-spectrum Precision survey, ECM, Signals intelligence, chemical/biological/radiological/nuclear detection, and more		15-16,000	14+ Hours / Dual Payload	140	Long Range Outdoor Surveillance, Mapping, Surveying	JP-8, JP-8, Jet A, Jet A1
Textron	Shadow M2		Fixed Wing	Day/Night full motion vision, Multi-spectrum Precision survey, ECM, Signals intelligence, chemical/biological/radiological/nuclear detection, and more		18-20,000	14+ Hours / Dual Payload	Balloon Capable	Long Range Outdoor Surveillance, Mapping, Surveying	AvGas
Trimble	UAS		Fixed Wing	2x 1MP cameras, 4K HD		16,000	35	60	Outdoor Surveillance	Electric
UAS Technologies	Silent Falcon	\$250-300k	Fixed Wing	MWIR/FLIR/DSLR/Multispectral/Imager/Hyperspectral Imager/Magnetometric Sensor		20,000	5-7 hours	10-15 (up to 100)	Long Range Outdoor Surveillance	Electric
UAV Factory	Penguin Series	\$16.5k+	Fixed Wing	640X480 IR MWIR 24 FPS		30,000	20-45 hours	100	Long Range Outdoor Surveillance	28cc Engine
Yuneec	Typhoon 4K	\$900	4 Rotor	4K camera	No			25	Outdoor Surveillance	Electric

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## UAVs Currently Recommended

Brand	Model	Price	Payload	Customizable Payload?	Flight Time (minutes)	General Notes	Link	Used By
3D Robotics	Solo (Enterprise Edition)	\$2,649	Go Pro	Multiple Cameras	20-25	US Made, Mapping Software Included	<a href="https://3dr.com/enterprise/">https://3dr.com/enterprise/</a>	
DJI	Inspire Pro	\$4,000+	360, 3 axis 4k Camera	Yes	15	Similar to Inspire 1 but with upgraded gimbal, camera, and controls	<a href="http://www.dji.com/product/inspire-1-pro-and-raw">http://www.dji.com/product/inspire-1-pro-and-raw</a>	SDG&E
DJI	Matrice 100	\$4,300	FLIR/DSLR	Yes	40	Vision Processing, 360 degree obstacle avoidance, FLIR Options	<a href="http://www.dji.com/product/matrice100">http://www.dji.com/product/matrice100</a>	
DJI	Phantom 4	\$1,400	4K Camera	No	28	Limited Sense & Avoid Technology	<a href="http://www.dji.com/product/phantom-4">http://www.dji.com/product/phantom-4</a>	
DJI	S1000	\$4,000+	DSLR Camera	Yes	15		<a href="http://www.dji.com/product/spreadwings-s1000">http://www.dji.com/product/spreadwings-s1000</a>	Duke Energy
Yuneec	Typhoon 4K	\$900	4K camera	No	25		<a href="http://www.yuneec.com/Typhoon-Specifications-Typhoon-4K">http://www.yuneec.com/Typhoon-Specifications-Typhoon-4K</a>	

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## UAV Safety Guidelines

- Flight ceiling of 400 feet
- Must be in visual control of the operator
- Must not interfere with manned aircraft
- 25 feet minimum from individuals & “vulnerable” property
- Do not photograph people where there is an expectation of privacy
- Do not fly:
  - over people or vehicles
  - in adverse weather
  - while under the influence of alcohol or drugs
  - near “sensitive infrastructure” like power stations, correctional facilities, etc.



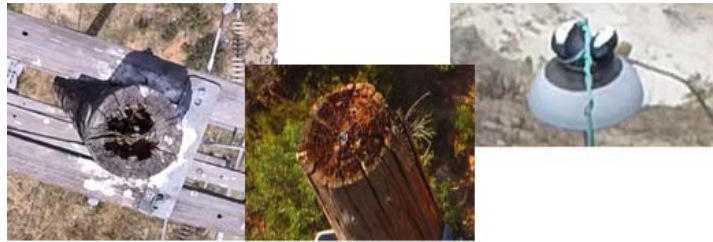
## Standard Templates included in Report

- Safety Procedures
- Standard Operating Procedures
- Maintenance Procedures
- Incident Reporting Procedures
- Training Plan



## UAV Benefits to the Industry

- ***Inspections of poles, members, or structure conditions*** (or deterioration); pole attachments; or assessment of hardware/equipment condition



## UAV Benefits to the Industry

- ***Inspections of energized lines***



## UAV Benefits to the Industry

- **Land and facility inspections** could include a review of a flood area or a rooftop survey of facility assets; pre-construction flights adjacent to a right of way to get imagery of entire lines without having to walk/drive; observations for endangered species; or security oversight



## UAV Benefits to the Industry

- **Thermal imaging** of electric utility equipment (such as substations) or alternate energy generating plants (including PVs and wind generators)



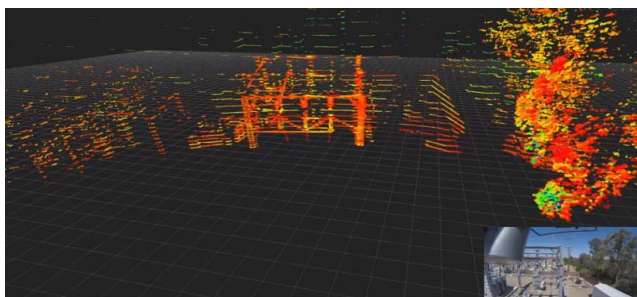
## UAV Benefits to the Industry

- **Corona Detection** to measure an ionization field and check for problems with connection points or splices in high voltage situations



## UAV Benefits to the Industry

- **Light Detection and Ranging (LIDAR) Inspections** to measure conductor sag or create 3D imagery of structures to virtually reconstruct a tower





## UAV Benefits to the Industry

- **Line Spooler** to launch a finger line string over a cross arm for initial installation of a new overhead line



## UAV Benefits to the Industry

- **Future Applications for Small Material and/or Tool Delivery-**
  - Wal-Mart, Google, and Amazon have all expressed an interest in this subject
- **Marketing and Business Development-**
  - Opportunity to showcase your UAV capabilities in a new area of business; generate marketing materials and aerial views of installations; augmenting utility maps and records



## Additional Benefits

- General Maintenance and Operations
- Storm damage assessment
- Development of an effective automated inspection system for transmission line/tower monitoring applications
- Increase the efficiency, reliability, safety, and security of electric power transmission

All without the use of major equipment (bucket trucks, helicopters, etc.) and with no impact to the environment



## Thank You!



Questions?

*Don't forget...*

- 10:15 - 11:30 am – Special Session:  
Boston Strong
- 11:30 am - 4:00 pm – NECA Show Hours

