

**Phoenix Air Unmanned (PAU)/Harris Corporation
Application for Special Temporary Authorization**

NARRATIVE STATEMENT

Pursuant to Section 5.3 (d and j) and Section 5.61 of the Federal Communications Commission's ("FCC") regulations, Phoenix Air Unmanned, LLC (PAU) in collaboration with Harris Corporation (Harris) hereby respectfully requests a Special Temporary Authorization ("STA") from 1 May 2019 to 31 October 2019 to operate in the 24.45-24.65 GHz band to test the Echoguard radar developed by Echodyne Corporation. Operational and engineering data will be collected during field testing in relation to an ongoing unmanned aircraft systems (UAS) research project.

Echodyne Corporation's EchoGuard radar is a high performance ultra-low cost, size, weight, and power electronically scanning ground-based radar. This requested STA is to enable PAU and Harris to operate and validate performance of the radar in specific ground-based radio-navigation scenarios, while flying UAS along ~2,500 miles of Xcel Energy transmission line infrastructure. This testing is a temporary, non-recurring service where a regular authorization is not appropriate as it is associated with a joint test initiative between Xcel Energy and the Federal Aviation Administration (FAA) under a limited FAA 14 CFR Part 107 waiver. The EchoGuard radar will be utilized on a temporary basis at each of the identified locations for a limited period-of-time.

In support of this request, the following summary is provided.

A. Purpose of Operation and Need for Special Temporary Authorization:

Xcel Energy teamed with Harris and PAU submitted (4 Jan 2019) a FAA 14 CFR Part 107 waiver request to fly a small UAS at low altitude (below 250 ft) in remote/non-urban areas, in uncontrolled airspace (Class G) along ~2500 miles of transmission line (represents <1% of Xcel Energy's critical infrastructure). This is part of the ongoing testing being conducted between Xcel Energy and the FAA to facilitate use of UAS in the National Airspace System in support of safe and reliable operation of the national electrical grid (FAA Partnership for Safety Plan MOU #2016-PSP-0921). Initial shorter transmission line segment testing (e.g., 50 miles) was accomplished, and this next level of testing will provide real-world technical and operational data across multiple geographic locations. Each sub-area has geographic and operating environment differences providing a variety of UAS utility line inspection and radar performance testing opportunities.

The Echodyne EchoGuard radar will be installed as a transportable fixed station (FX) on a PAU operations vehicle that is planned to be parked at/near each submitted location that is also associated with a UAS take-off/landing zone (LZ). The radar and other equipment will be turned on and operated during the UAS flight operations at each LZ estimated for ~2 hours. The radar will be oriented down the transmission line to detect possible manned aircraft in vicinity. Based partially on this data, the UAS pilot may navigate the UAS to remain well clear of the manned aircraft. The radar will be shut-off while the operations vehicle drives to the next LZ to redeploy. The ~2500 miles are planned to be flown over a 6-month period (1 May-31 Oct 2019), with the radar typically being operated at each location one time for ~2 hours over the 6-month period.

The point of contact within the FAA Spectrum Management Office is Don Nellis (donald.nellis@faa.gov), and he is aware of this multiple location STA for transmit authorization of the Echodyne Echoguard ground radar for the FAA-Xcel Energy project.

B. Location of Proposed Operations:

PAU/Harris proposes to test the radars on the ground within a specified area of operation. By this application, Harris seeks authority to conduct tests at the following locations. Figure 1 is the overview of ~2500 miles of transmission line (in green) that the UAS will operate over. Figures 2-9 are a description by State of the latitude/longitude radar locations/LZs and corresponding image with the transmission line in green, a helicopter icon marking radar location/LZ, and 5-mile radius of operation red circle around each radar location/LZ.

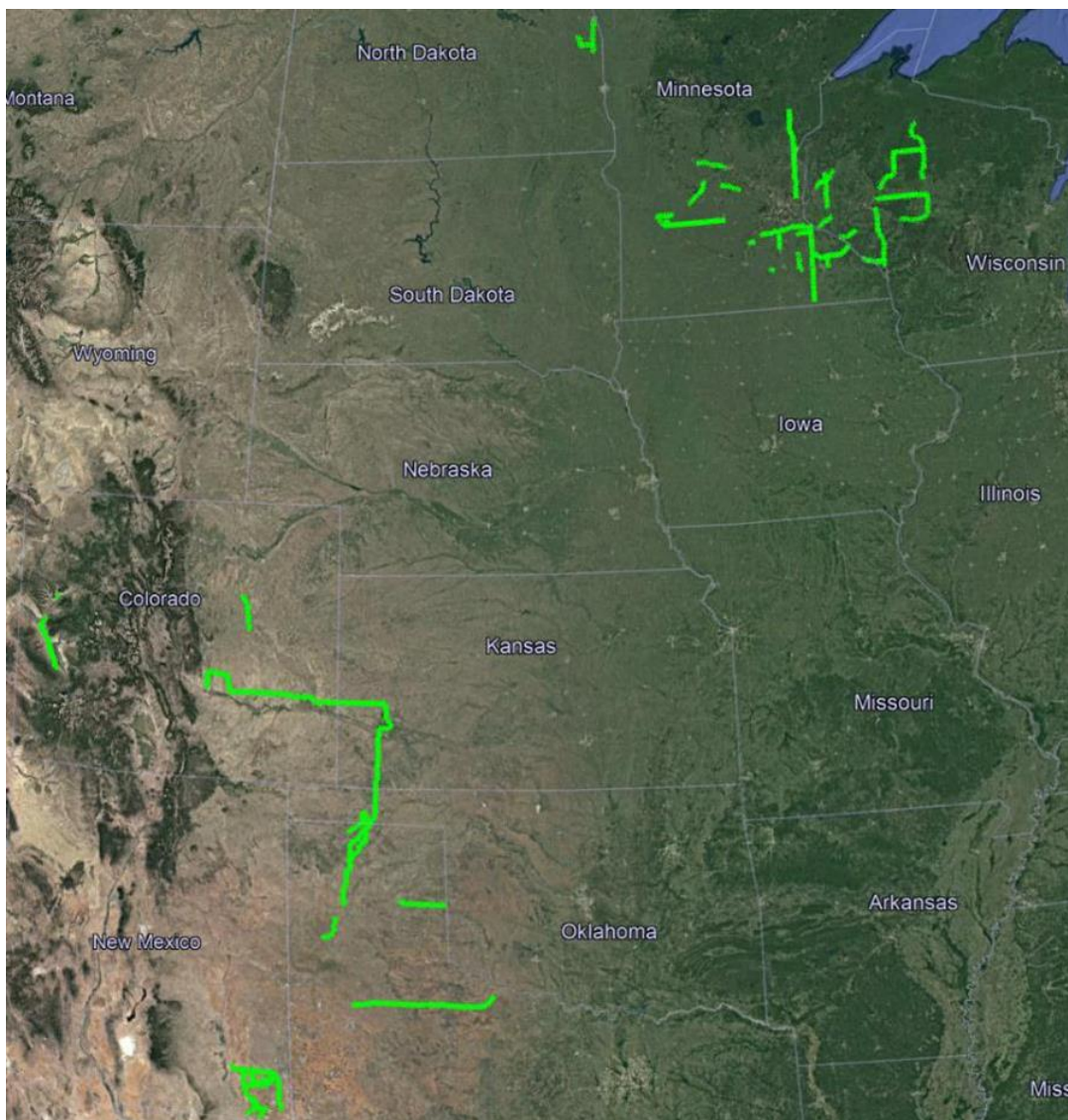


Figure 1 ~2500 miles Xcel Energy Transmission Line for UAS Operations under FAA 14 CFR Part 107 Waiver (Green = Transmission Line)

#	LAT	LONG
1	47.89554763	-97.06721813
2	47.88143203	-97.06631691
3	47.86048176	-97.06718594
4	47.82157429	-97.06666559
5	47.70117707	-97.06516214
6	47.58507274	-97.06750102
7	47.52711194	-97.07067676
8	47.48328605	-97.04836078
9	47.40430331	-97.07146735
10	47.52703908	-97.092174
11	47.52691443	-97.28365342
12	47.50589263	-97.32655211
13	47.61411703	-97.34534904
14	47.64339075	-97.45187741

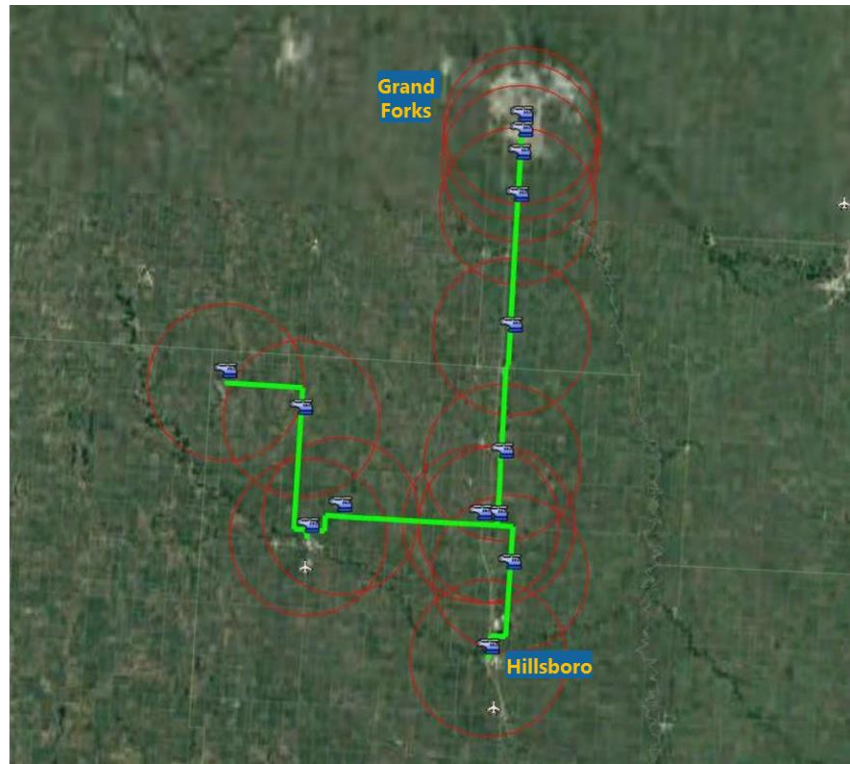


Figure 2 North Dakota Locations

#	LAT	LONG	#	LAT	LONG	#	LAT	LONG
1	43.55753124	-92.67934681	46	44.18789441	-92.21957444	91	45.62924188	-94.58629377
2	43.63029533	-92.67743708	47	44.21593713	-92.05586514	92	45.63656086	-94.6248938
3	43.73210399	-92.67472613	48	44.81392808	-94.35664045	93	45.64118921	-94.62501182
4	43.74215721	-92.6866464	49	44.81697242	-94.39612257	94	45.66392031	-94.69344033
5	43.79968761	-92.68086655	50	44.81701808	-94.39614402	95	45.67322355	-94.78863729
6	43.90655377	-92.67837306	51	44.81230851	-94.58530758	96	45.46144265	-92.91167867
7	44.03331465	-92.67019206	52	44.81306812	-94.75205503	97	45.03713351	-92.91329301
8	44.15151291	-92.67271097	53	44.81181017	-94.91525592	98	45.26572214	-92.8801446
9	44.26807126	-92.67049235	54	44.81173406	-94.99549689	99	45.15526212	-92.9136592
10	44.28091537	-92.65581531	55	44.80350811	-95.03585054	100	45.38409737	-92.91565991
11	44.36917115	-92.66349621	56	44.80801601	-95.0774939	101	45.52791067	-92.90748848
12	44.50008833	-92.66479179	57	44.80942382	-95.25957889	102	45.67313886	-92.90632976
13	44.5557359	-92.66569206	58	44.80608983	-95.44263429	103	45.68980777	-92.90816044
14	44.60054908	-92.66376087	59	44.80601659	-95.52692537	104	45.71634331	-92.89554665
15	44.62417252	-92.63479838	60	44.80595049	-95.52701886	105	45.77703555	-92.84346833
16	44.62641108	-92.77265528	61	44.90534732	-95.51484472	106	45.52788351	-92.90703374
17	44.6373039	-92.94378019	62	44.94753891	-95.49322977	107	45.67307154	-92.90635213
18	44.61604998	-93.07049627	63	44.9485798	-95.37086551	108	45.68983185	-92.90802582
19	44.60161423	-93.22021978	64	44.94865787	-95.51335432	109	45.71657349	-92.9097329
20	44.59688423	-93.2949283	65	44.94942627	-95.65447091	110	45.744534	-92.91001721
21	44.5872772	-93.39802853	66	44.94935427	-95.69442766	111	45.86756278	-92.8980331
22	44.5728838	-93.51969485	67	44.94015065	-95.72224753	112	45.98332014	-92.95043608
23	44.55656357	-93.65798704	68	44.91826612	-95.69611613	113	45.98575046	-92.95513531
24	44.59676515	-93.2951191	69	44.8338498	-95.60938526	114	46.07906839	-92.96088011
25	44.52013272	-93.29206944	70	44.79866784	-95.55508223	115	46.21199091	-92.95482859
26	44.49382327	-93.29238594	71	45.22912304	-94.00882452	116	46.31804226	-92.95415617
27	44.37076327	-93.29187213	72	45.24973923	-94.09089793	117	44.06523458	-93.49482893
28	44.3361782	-93.29156467	73	45.2584324	-94.11446271	118	44.05147979	-93.46578597
29	44.47098117	-93.7591331	74	45.26526479	-94.1341558	119	44.04767766	-93.41699225
30	44.47142332	-93.86954087	75	45.29122155	-94.21205367	120	45.39185787	-94.71442393
31	44.46723184	-93.90318969	76	45.29227875	-94.22028398	121	45.37697176	-94.76314715
32	44.51248479	-92.93888791	77	45.30874742	-94.30000615	122	45.39194737	-94.73617726
33	44.53706606	-92.91759734	78	45.30873094	-94.30005723	123	45.36356011	-94.76263911
34	44.54289625	-92.74714812	79	45.2716914	-94.31275272	124	45.33334671	-94.7636456
35	44.54107513	-92.70717702	80	45.31741342	-94.40778808	125	45.28053245	-94.77918405
36	44.02747673	-92.8594805	81	45.66561521	-94.88607756	126	45.20379311	-94.88881157
37	44.02992203	-92.87923154	82	45.67329617	-94.83680539	127	45.11475083	-95.00764967
38	44.13881759	-92.92645987	83	45.56956499	-94.33086566	128	45.11475083	-95.00763894
39	44.27851891	-92.93983806	84	45.60364075	-94.3919491	129	45.08232668	-95.0520036
40	44.22425288	-92.65745883	85	45.58756242	-94.39638715			
41	44.18563729	-92.54835853	86	45.60604589	-94.44188538			
42	44.17227218	-92.39920625	87	45.61463933	-94.4728488			
43	44.08628583	-92.37931811	88	45.61467685	-94.50817939			
44	44.01597068	-92.37860437	89	45.61510462	-94.52382203			
45	44.17214046	-92.39922663	90	45.62350956	-94.57273788			

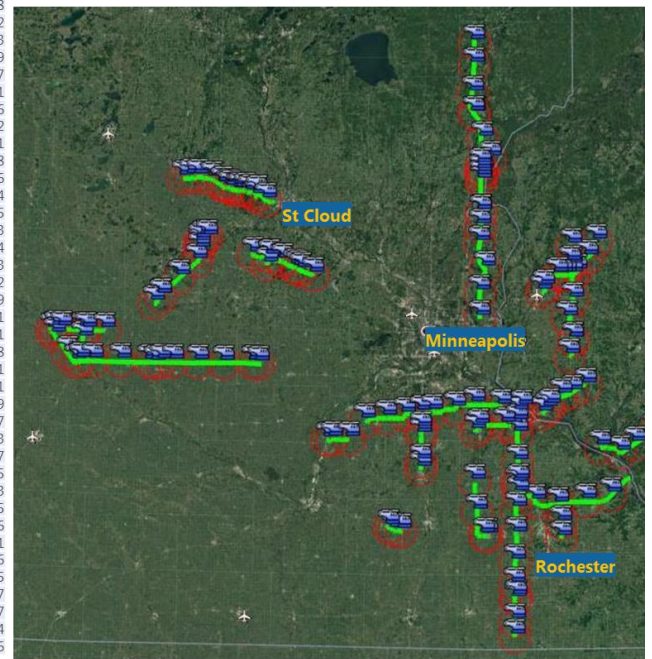


Figure 3 Minnesota Locations

#	LAT	LONG	#	LAT	LONG	#	LAT	LONG
1	45.56701598	-90.31094493	36	44.57460913	-90.48113822	71	44.61573094	-92.47332807
2	45.67588606	-90.34977667	37	44.58227367	-90.44896514	72	44.59423216	-92.50418286
3	45.73592545	-90.4497694	38	44.64133897	-90.35579328	73	45.23803066	-92.30552462
4	45.79474443	-90.53283625	39	44.75671659	-90.35826797	74	45.1209253	-92.29983821
5	45.89552695	-90.47481273	40	44.85730713	-90.33618419	75	45.03491035	-92.33961402
6	45.93833448	-90.47619396	41	44.91075943	-90.33544752	76	44.93793294	-92.30018978
7	45.5304423	-90.32212683	42	44.90778715	-90.49675913	77	44.93466482	-92.29957388
8	45.42354466	-90.33119265	43	44.91739007	-90.53589196	78	44.86015552	-92.32642293
9	45.32261257	-90.35212193	44	44.91846201	-90.7094114	79	44.11872432	-91.69478516
10	45.30884598	-90.29112577	45	44.91910923	-90.88561223	80	44.10217282	-91.68107102
11	45.24909446	-90.38415819	46	44.91862562	-91.08649899	81	44.09298144	-91.66688318
12	45.15312602	-90.39510323	47	44.91880456	-91.26995354	82	44.08520986	-91.65732915
13	45.12647319	-90.37442912	48	44.80071583	-91.37315292	83	44.07161003	-91.6215002
14	45.53745992	-90.33125718	49	44.7308394	-91.3665191	84	44.06728355	-91.53107489
15	45.54916322	-90.41905922	50	44.73438733	-91.36666394	85	44.0671525	-91.53111244
16	45.55199375	-90.59754595	51	44.62141062	-91.35708981	86	44.02792265	-91.45714575
17	45.55235695	-90.77165534	52	44.52177713	-91.35717774	87	44.02000457	-91.30575079
18	45.55506087	-90.95691145	53	44.43045667	-91.33610332	88	45.95264164	-90.44587662
19	45.51018066	-90.92572379	54	44.3362331	-91.27312822	89	45.95131387	-90.4670768
20	45.48292568	-90.92510152	55	44.29287734	-91.25486148	90	45.73661945	-90.41056555
21	45.36632002	-90.94553277	56	44.1864918	-91.26741854	91	45.72325059	-90.39691811
22	45.2854221	-90.9507228	57	44.14163927	-91.28362562	92	45.70738813	-90.39133376
23	45.12957199	-91.05229072	58	44.06767779	-91.28684076	93	45.25220797	-92.27515589
24	45.19574798	-91.13833104	59	43.99871458	-91.2875891	94	45.15842515	-92.50762588
25	45.17158888	-91.15221871	60	43.98437586	-91.28828111	95	45.1805928	-92.48983244
26	45.15758119	-91.15229973	61	43.97208712	-91.28715739	96	45.23746403	-92.40182874
27	45.14212215	-91.18236737	62	43.95364385	-91.28083274	97	45.23790221	-92.37215278
28	45.05023442	-91.2712826	63	44.43735897	-92.12451342	98	45.23793621	-92.34673617
29	44.59604856	-90.9127187	64	44.40973771	-91.9947756	99	45.28211202	-92.30678413
30	44.59457272	-90.79786945	65	44.51344049	-91.77217711	100	45.29139087	-92.31696268
31	44.57329868	-90.72989922	66	44.45123869	-91.89684618	101	45.37260605	-92.30845471
32	44.56807745	-90.62818031	67	44.72491281	-92.21632838	102	45.31807463	-92.200881
33	44.56302952	-90.59482316	68	44.69212943	-92.30937153	103	45.3908946	-92.14157812
34	44.56006928	-90.55803935	69	44.67724414	-92.3775125			
35	44.56841261	-90.51702082	70	44.62943608	-92.45229418			

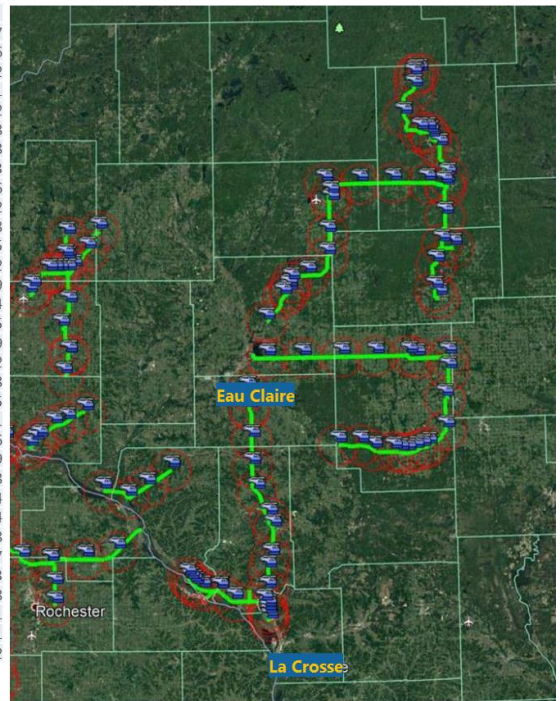


Figure 4 Wisconsin Locations

#	LAT	LONG	#	LAT	LONG
1	38.20203721	-102.1221336	31	39.17232702	-103.8502915
2	38.20215352	-102.2758819	32	39.19818146	-103.8449625
3	38.20202246	-102.4308599	33	39.28559519	-103.8622574
4	38.20618222	-102.5275576	34	39.35352308	-103.8676647
5	38.26756903	-102.578988	35	39.35352308	-103.8676647
6	38.26568047	-102.7420139	36	39.43013655	-103.881226
7	38.26661941	-102.9028735	37	39.50275863	-103.8981346
8	38.29558307	-103.0438201	38	39.57894345	-103.9127259
9	38.29414808	-103.2096837	39	39.62417786	-103.9671425
10	38.29562347	-103.3716385	40	39.68406465	-104.0208725
11	38.30016557	-103.538454	41	39.1486524	-108.3163185
12	38.29938187	-103.6863626	42	39.10991753	-108.3276638
13	38.29859041	-103.748558	43	39.09446415	-108.341251
14	38.29892522	-103.889757	44	39.04602833	-108.4131525
15	38.29445503	-104.0549935	45	38.99271391	-108.3960936
16	38.29220675	-104.1838457	46	38.95657714	-108.3619008
17	38.25548442	-104.2249817	47	38.90550448	-108.32753
18	38.35916099	-104.2211901	48	38.85667284	-108.2840568
19	38.43458364	-104.2525813	49	38.82179766	-108.2267794
20	38.52145797	-104.2553077	50	38.76831451	-108.1960735
21	38.53549901	-104.3843647	51	38.7135144	-108.1724126
22	38.54743944	-104.4965185	52	38.66158718	-108.1515021
23	38.56024288	-104.6107055	53	38.60768593	-108.1167925
24	38.56010434	-104.6501277	54	38.5568889	-108.0802742
25	38.55900951	-104.6914498	55	38.50797629	-108.0396367
26	38.49052491	-104.6902298	56	38.45367704	-108.0383706
27	38.3761918	-104.6901819	57	38.4214707	-107.9945267
28	38.34861155	-104.6901862	58	38.43885534	-107.9505323
29	38.32159625	-104.6901366	59	39.49159092	-108.1159241
30	38.32070493	-104.6723634	60	39.47391824	-108.0937345
			61	39.4653348	-108.0428244
			62	39.46539278	-108.0426956

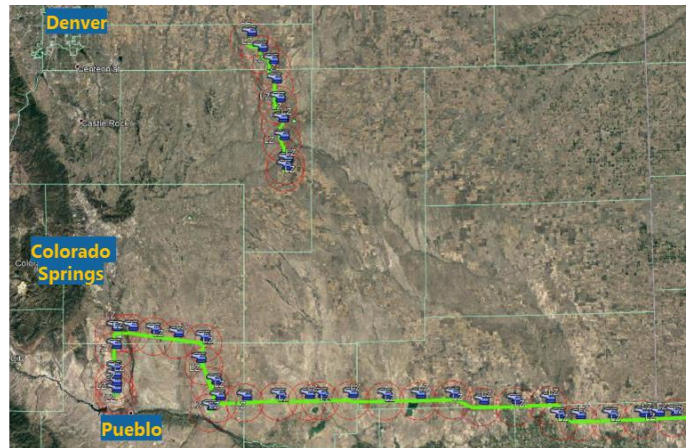


Figure 5 Colorado Locations

#	LAT	LONG
1	37.06747247	-101.2842698
2	37.17342842	-101.2485457
3	37.30558035	-101.2487603
4	37.43140067	-101.2339974
5	37.56027581	-101.2353707
6	37.69380162	-101.2352848
7	37.8283416	-101.2161661
8	37.85813083	-101.1040712
9	37.91589575	-100.9745956
10	37.98679937	-101.0645462
11	38.1050535	-101.0658122
12	38.20662822	-101.0854245
13	38.20614768	-101.2684423
14	38.20584839	-101.4143223
15	38.20481141	-101.5974528
16	38.2041844	-101.7797357
17	38.20398206	-101.9637567



Figure 6 Kansas Locations

#	LAT	LONG
1	35.3826413	-99.99620864
2	36.58035102	-101.331541
3	36.68900192	-101.2948055
4	36.80057511	-101.295932
5	36.93572713	-101.2895484
6	36.51534582	-101.5477286
7	36.55043796	-101.4306755
8	36.64570001	-101.4834218
9	36.66029403	-101.4782346
10	36.66011545	-101.5101861
11	36.66054764	-101.5465921
12	36.63875306	-101.5457813
13	36.51526191	-101.5482329

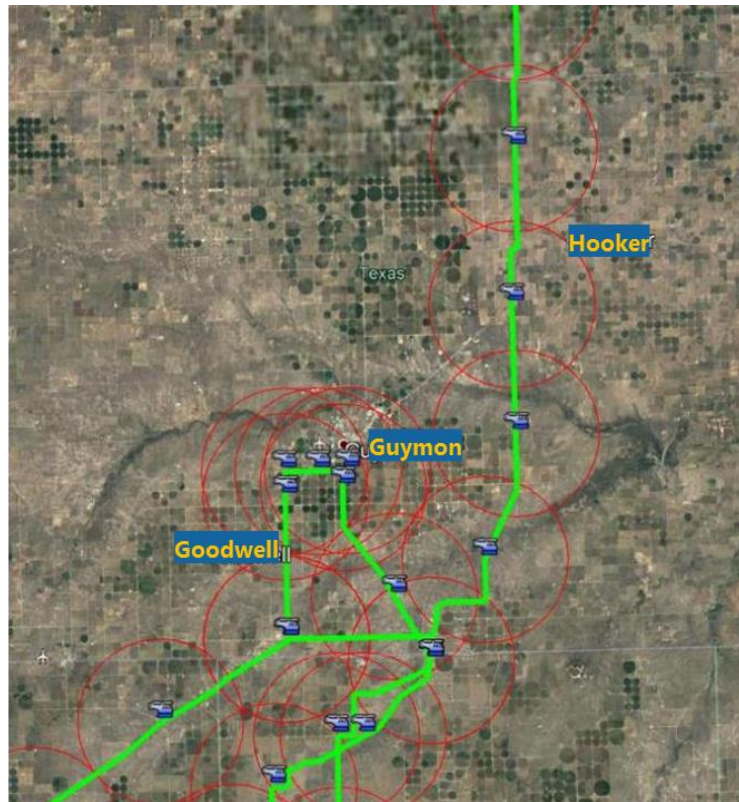


Figure 7 Oklahoma Locations

#	LAT	LONG	#	LAT	LONG
1	34.08588687	-99.19618617	31	35.37290232	-100.2007295
2	33.9482509	-99.35784931	32	35.39986261	-100.8910251
3	34.0491744	-99.23907037	33	35.37155381	-100.0687463
4	33.91782769	-99.51598577	34	35.30778024	-101.9218138
5	33.92147426	-99.66497066	35	35.41490987	-101.9403211
6	33.91939988	-99.82612851	36	35.55011453	-101.9354287
7	33.92398207	-99.9966526	37	35.66220445	-101.8752292
8	33.93953343	-100.1478109	38	35.77989947	-101.8667105
9	33.93293937	-100.3121767	39	35.82995518	-101.7954482
10	33.93176434	-100.4783556	40	36.03455733	-101.7931093
11	33.92113955	-100.6394652	41	36.0031526	-101.7933015
12	33.9209793	-100.7721058	42	35.96574967	-101.7943092
13	33.92178056	-100.9466103	43	36.06169693	-101.7930647
14	33.92154018	-101.0966316	44	36.18308041	-101.787314
15	33.92098821	-101.2716833	45	36.24024763	-101.7014404
16	33.92032986	-101.428794	46	36.31857255	-101.6124426
17	33.89578982	-101.5472618	47	36.38764694	-101.5654932
18	33.88360622	-101.6945687	48	36.43037081	-101.4678769
19	33.8695858	-101.8360177	49	36.49412359	-101.3924531
20	34.82119532	-102.3599434	50	35.30780525	-101.9218402
21	34.82990829	-102.3299451	51	36.01068921	-101.7575048
22	34.84283562	-102.3036595	52	36.06735766	-101.6683422
23	34.8483124	-102.2764871	53	36.12786766	-101.5963302
24	34.90453829	-102.1491143	54	36.2121917	-101.5513978
25	35.0150294	-102.132828	55	36.31385552	-101.4969812
26	35.11201297	-102.0994631	56	36.43061558	-101.4965735
27	35.14780271	-102.0990357	57	36.49405335	-101.3923107
28	35.37488695	-100.716683	58	35.96614657	-101.8619655
29	35.37145009	-100.5387308	59	36.49400752	-101.3922311
30	35.37216746	-100.3793861	60	36.44562699	-101.6863427
			61	36.35377244	-101.8242891

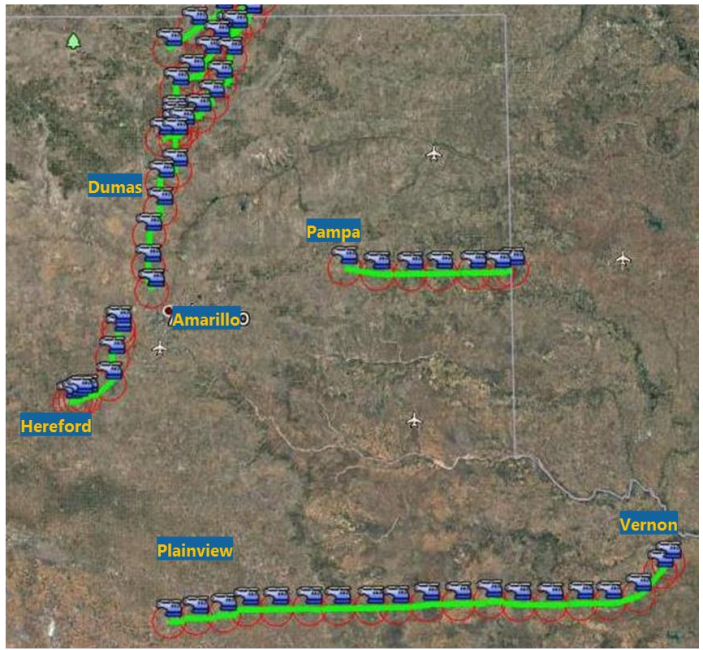


Figure 8 Texas Locations

#	LAT	LONG
1	32.77082406	-104.1303134
2	32.71438486	-103.351446
3	32.81465732	-104.2380384
4	32.77312299	-103.974504
5	32.7692468	-103.8072449
6	32.77096103	-103.6533384
7	32.77064322	-103.4904431
8	32.76832644	-103.3768253
9	32.66811487	-103.2956518
10	32.61187367	-103.311214
11	32.53487955	-103.2963781
12	32.5171268	-103.2793379
13	32.3966396	-103.2960959
14	32.29343852	-103.2856031
15	32.21018362	-103.2625267
16	32.15101062	-103.6232174
17	32.21214058	-103.5312069
18	32.19619009	-103.5943461
19	32.22610971	-103.742262
20	32.32552165	-103.8291783
21	32.40625979	-103.902824
22	32.50515542	-103.9671112
23	32.09320163	-103.7256918
24	32.5721166	-103.9757222
25	32.66805717	-103.9723855
26	32.66808053	-103.972125
27	32.72570063	-103.9610939
28	32.56072623	-103.8039804
29	32.51743389	-103.9318788
30	32.71445897	-103.3517205
31	32.50516596	-103.9672892
32	32.60854987	-103.6595827
33	32.6632152	-103.5040345
34	32.65325962	-103.3989518
35	32.558773	-103.5804964
36	32.55971557	-103.7379058
37	32.56061316	-103.8039352
38	32.71343675	-103.300251
39	32.58593175	-103.5164755
40	32.64151209	-103.8084967
41	32.76361518	-103.7768234
42	32.81248771	-103.7734495
43	32.23149056	-103.7253039
44	32.29155973	-103.7914714
45	32.37375123	-103.7911206
46	32.09761431	-103.9279448
47	32.16386027	-103.8421762

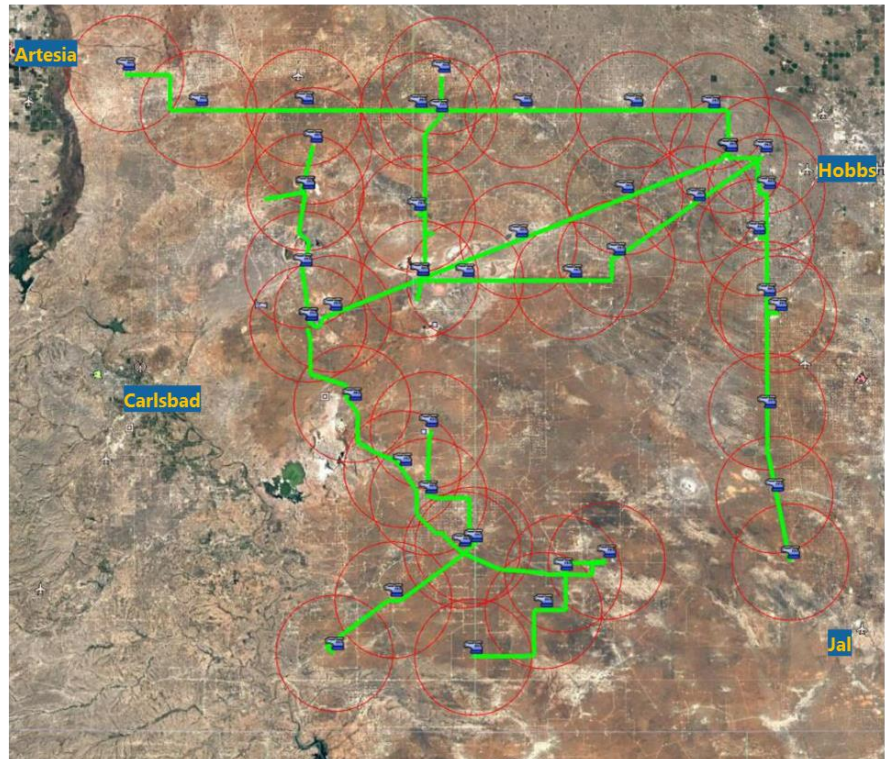


Figure 9 New Mexico Locations

C. Technical Specifications:

1. Frequencies Desired

PAU/Harris requests authorization to operate in the 24.45-24.65 GHz band.

2. Effective Radiated Power

The units to be deployed operate at a peak maximum transmitter power output of 4W, and a peak maximum effective radiated power of 486W.

PAU/Harris will reduce the actual powers to the minimum power needed for successful operation, based on set-up and testing. Operations will be conducted to comply with rules relating to human exposure to radiation.

3. Modulation and Emissions

The radar uses linear FM modulation. The primary emission designator is 190MFXN. Other emission modes may be utilized, but in no event will the emissions extend beyond the frequency bands requested.

4. Antenna Information

No antennas will be mounted in a fashion that will require approval under FAA and FCC rules and regulations. The radar will be mounted on top of a mobile operations vehicle at <6 meters above ground.

5. Equipment To Be Used

The tests will be conducted with two Echodyne EchoGuard (formerly MESA-SSR) ground radar units.

D. Protection Against Causing Interference:

As noted above, PAU/Harris has requested authority to operate in the 24.45-24.65 GHz band. A search of the Commission's Universal Licensing System database was conducted and determined that there are no licensed operations in that spectrum.

In the event that it receives a complaint of harmful interference resulting from the proposed operation, PAU/Harris will take immediate action to address the interference, including if necessary discontinuing operations. PAU/Harris has designated William Wheeler, whose contact information is provided below, to act as the "Stop Buzzer" for this purpose.

Furthermore, the length of the test period is short, extending only from 1 May 2019 to 31 October 2019. During that period, the proposed operations are limited in scope. PAU/Harris will typically transmit at each location one time for ~2 hours over the 6-month period

In summary, the proposed operation should not interfere with any licensed operation.

E. Restrictions on Operation:

PAU/Harris recognizes that the operation of any equipment under experimental authority must not cause harmful interference to authorized facilities. Should interference occur, PAU/Harris will take immediate steps to resolve the interference, including if necessary discontinuance of operation.

In addition, PAU/Harris will advise entities using the equipment that permission to operate has been granted under experimental authority, that such operation is strictly temporary, and that the equipment may not cause harmful interference.

F. Public Interest:

Grant of an authorization will permit PAU/Harris in cooperation with Xcel Energy and the FAA to develop an innovative approach to conducting critical infrastructure inspections with UAS in the National Airspace System in support of safe and reliable operation of the national electrical grid.

G. Contact Information:

For questions, please contact:

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In the unlikely event interference concerns should arise during the period of authorization requested by this application, please contact the company's "Stop Buzzer" identified below:

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Phoenix Air Unmanned, LLC
wwheeler@phoenixair.com
Mobile +1-678-313-1768
100 Phoenix Air Drive SW, Cartersville, GA 30120