Technical Specification for use of Drones in Transmission line

1. **Scope**

Drone patrolling of EHV (400 kV AC, 765 kV AC/ ± 500 kV HVDC, ± 800 kV HVDC, ±320 kV HVDC) transmission lines through Thermal, visual And LiDAR sensors.

The transmission lines, on which drone patrolling is to be carried out, are situated in following regions:

Package	Regions	Total
DP-01	Eastern Region-I, Eastern Region-II Western Region-I, Western Region-II, Northern Region-I, Northern Region-II, North-Eastern-Region, Southern Region-II, Odisha	900 kms

The scope of work includes but not limited to following:

a. Facilities such as vehicle for movement of personnel and Ground survey/ Recce/ Local assistance, if required, shall be carried out by the successful bidder.

b. Acquired data shall be the property of the Employer and bidder shall not use it for any purpose.

c. Submission of Raw data to employer immediately after completion of each flight in suitable portable hard disk which shall be retained by the employer.

Tower Inspection Drones:

d. Providing suitable programmable Drone/ UAS having Thermal Visual sensors, capable of completing Transmission line patrolling of minimum 20 towers/ day.

e. Tower inspection Defect reports of the flights completed in a day shall be submitted to POWERGID by 10 AM of next day using Artificial Intelligence based software along with all the data.

f. Minimum number of photographs captured will be as specified below
   I. 1 photograph covering complete tower and nearby terrain.

   II. Photographs shall be marked with identification such as Top, Middle, Bottom phase wrt the tower along with the Ckt identification.

III. For capturing any defect in upper portion of towers, following numbers of close photographs are to be taken

a. No of photos of Tower and Its parts:

Sl. No	Main component	Sub-components to be checked	No. of photographs to be taken	S/C		D/C		M/C	
				Sus	Ten	Sus	Ten	Sus	Ten
1	Insulators	CC ring, grading ring, insulator surface, arcing horns, hardware cotter pins, VD etc.	1 of each string and hardware fittings	3	6	6	12	12	24
2	Earth peaks	Copper bond, nut bolts/ members, vibration dampers etc.	1 of each peak	2	2	2	2	2	2
3	Cross arms	Bird guard, nut bolts/ members, foreign material etc.	1 of each cross arm	3	3	6	6	12	12
4	Jumper including dead end	Jumper pads, jumper bolts, rigid spacers, jumper drop, dead end etc.	1 of each jumper pads and 1 of each jumper	0	6	0	12	0	24
5	Main tower body above	Nut bolts/ members,	1 no. per face	4	4	4	4	4	4

	cross arm level	foreign material etc.							
6	Tower leg	Foundation, coping, counterpoise earthing, joint plates, bolts and nuts etc.	1 of each leg	4	4	4	4	4	4
7	Main tower body below cross arm level	Nut bolts/ members, foreign material etc.	1 no. per face	4	4	4	4	4	4
Total Photos				20	29	26	44	38	74

b. No of forward span photos:

Sl. No	**Main component**	**Sub-components to be checked**	**No. of photographs to be taken**	**S/C**		**D/C**		**M/C**	
				Sus	**Ten**	**Sus**	**Ten**	**Sus**	**Ten**
1	Forward span	Conductor / EW damaged/OPGW joint box	1 photo in every 50 meters especially near spacer per phase	18	18	36	36	72	72

The detail of photo capturing sequence has been attached as Annexure 1.

g. For Tower Inspection works following defects shall be identified:

(a) Visual inspection

I. Missing/ damaged/ bent/ hanging tower members, missing tower bolts and bird guards
II. Damage to foundation, revetment, etc.
III. Broken insulators/ Pollution on Insulators/ Flashover marks on insulators
IV. Conductor/ Earthwire damage
V. Damage/ displacement/ missing/ wrongly oriented Hardwares like Vibration dampers, Grading Ring, Corona Rings, Spacer-Dampers, Spacers, missing copper bonds etc.
VI. Any other visual defect/ observation like bird nests, foreign material, construction in right of way etc.
VII. Missing/ loose jumper bolts
VIII. Flood/land slide/ mining activities/ excess spoil/ damaged foundation & coping/ waterlogging.
IX. Defects of OPGW cable joint/ JB

(b) Thermal Inspection:

I. Hotspots on all bolted joints (Jumper Joints), Mid Span Compression Joints/ repair sleeves for conductor, repair sleeves and Dead End Compression Joints using thermovision technique.

Vegetation inspection/ Clearance Inspection Drones:

h. Drones which will be deployed for vegetation management/ clearance measurement shall be equipped with LIDAR sensors.

i. Vegetation inspection/ Clearance inspection reports shall be submitted with in next 5 days of data acquisition.

j. Measurement of distances:

I. between different phases (vertical and horizontal),
II. between earthwire/OPGW and top conductor(s),
III. between bottom conductors and ground profile/ vegetation/ structure/ building/ other object in ROW,
IV. Jumper drops,
V. between conductors and side objects (tree/ hills etc.).
VI. measurement of clearance at crossings (power line/ road/ river/ railway line/ telephone line/ bridge etc.)

k. For ***Vegetation inspection/ Clearance Inspection*** required information for clearance measurement shall be captured on continuous basis to identify the defects mentioned at clause No 1. j above.

2. Specification:

2.1 Bidder shall have 1 no of standby drones having all clearances in ready to fly condition (RTF) of the same specification to replace a drone in case of breakdown.

2.2 The Drones shall comply the latest Drone rules/ regulations issued by the DGCA which includes Pilot license, UIN, Type Certificates, Insurance. Same shall be submitted at the bidding stage.

2.3 If due to any technical anomaly Successful bidder has to change the Drone in between the execution of project, the documents / permission specified in para 2.2 shall be submitted for the new drone also.

2.4 The Drone/ UAS shall be capable to work in Electro Magnetic field.

2.5 All photographs/videos captured through drones should be timestamped & geotagged and flightpath file of the same (in gpx format) shall be submitted to POWERGRID.

2.6 **Minimum specs for sensors / Drones used for Tower Inspection works:**

Digital Camera	Megapixel	20 MP and better
	Frame rate	30 frames/ Second
	Image quality	Full HD (1920 X 1080p) or better
Infrared Camera	Detector Technology	7.5 to 13 µm uncooled micro bolometer FPA
	Resolution:	640 x 480 pixels
	Focus:	Manual/ Auto
	Temperature range:	0 to 500° C
	Accuracy:	1% or 1° C for range up to + 150° C 2% or2° C for range above + 150° C
	Frames per second:	30 frames/ second
Drone	Hovering feature	Yes
	Range (minimum)	4 KM in radial direction
	Electromagnetic compliant	Yes
	Route Programmable	Yes

2.7 **Minimum specs for Vegetation inspection/ Clearance Inspection Drones:**

LIDAR	LAS file Version	1.2 or higher
	Accuracy:	Maximum 250mm
	Point density	200,000 pts/s Single Return Multiple Return – upto 4,00,000 pts/s
Drone	Fixed wing	Yes

	Range (minimum)	4 KM in radial direction
	Electromagnetic compliant	Yes
	Route Programmable	Yes

2.8 Tower Visual Inspection defect report shall contain:

- Date and time of patrolling,
- Name of line,
- Tower Location No./ Span,
- Longitude and Latitude of the tower location
- Defect noticed as per clause 1.g.(a) along with visual image
- Any other relevant information

2.9 Tower Thermal Inspection defect report shall contain:

- Date and time of patrolling,
- Ambient Temperature,
- Name of line,
- Tower Location No./ Span,
- Longitude and Latitude of the tower location
- Defect noticed as per clause 1.g.(b) along with thermal image Any other relevant information

2.10 Vegetation inspection defect report shall contain:

- Date and time of patrolling,
- Name of line,
- Tower Location No./ Span,
- Longitude and Latitude of the tower location
- Violation in clearances as per per clause 1.j.
- Any other relevant information

2.11 Brief technical information of transmission lines required to be patrolled (132 kV, 220 kV, 400 kV, 765 kV AC, +/- 500 kV HVDC bi-pole and +/- 800 kV HVDC bi-pole) is as under:

Sl. No.	Particulars	132 kV Tr. lines	220 kV Tr. line	400 kV Tr. line	765 kV Tr. line	+/- 500 kV HVDC Bi-pole line	+/- 800 kV HVDC Bi-pole line
a.	Nominal voltage (kV)	132	220	400	765	+/- 500	+/- 800
b.	Maximum System Voltage (kV)	145	245	420	800	+/- 525	+/- 840
c.	Type of structures	Self-supported type lattice structure					
d.	Ruling design span/ normal span (meters)	300/350	350	400	400	400	400
e.	Approximate height of tower without Extension • Single Circuit • Double Circuit	21 Meters 25 Meters	N/A 29 Meters	31 Meters 50 Meters	50 meters N/A	N/A 40 meters	N/A 45 meter/ 60 meter
f.	Right of Way (meters)	27	35	52/46	85/ 64	52	69
g.	No. of insulators in a string	9/10	14/15	23/ 24	35/40	38/41	112
h.	Type of insulator strings	Single I Sus. Single Tension	Single I Sus. Single Tension	Single I Sus. Double I Sus. Single V Sus. Double Tension Quad Tension	Double 'I' Sus. Single 'V' Sus. Double 'V' Sus. Quad. tension	Single 'V' Sus. Double 'V' Sus. Quad. tension	'Y' Sus Quad Tension
i.	Radio interference voltage at one MHz under dry condition	Not exceeding 1000 microvolts					
j.	Minimum live metal clearance (mm)	1200	1900	3050	5600	3750	7700
k.	Conductor	ACSR "Panther"	ACSR "Zebra"	ACSR "Moose" ACSR "Bersimis"	ACSR "Bersimis" ACSR "Lapwing"	ACSR "Bersimis" ACSR "Lapwing"	ACSR "Lapwing" bundle conductor

				ACSR "Snowbird" AAAC "Moose" bundle conductor	bundle conductor	bundle conductor	
l.	Conductor per phase	One	One	Two/ three/ four	Four	Four	Six
m.	Inter phase spacing	4600 mm	5200 mm	8000 mm	15000 mm	15000 mm	24000 mm
n.	Earth wire	7/3.15 mm Galvanized steel	7/3.15 mm Galvanized steel	7/3.66mm Galvanized steel	7/3.66mm Galvanized steel	7/3.66mm Galvanized steel	7/4.50 mm Galvanized Steel
o.	No. of Earthwires/ OPGW and their position	One	One	Two, run on top of the towers and conductors			

3. Non Disclosure Agreement:

Successful bidder shall sign non-disclosure agreement as per the standard format.

4. Safety Requirements

Entire aerial patrolling work is to be carried out under live line conditions and required electrical clearances are to be maintained during execution of work. The agency should have an established safety management system or safety program in effect that incorporates principles of a safety management system, work and safety rules for employees, which are appropriate to their work duties and comply with appropriate government regulations/POWERGRID safety rules.