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RIGHT OF WAY CALCULATION PLAIN/FOREST & URBAN

Voltage level	Configuration	Conductor type	Terrain	Ruling Span	String Type	Horizontal distance of Conductor attachment point from centre of tower In M	Width of right of way in M		Tentative Horizontal distance of Conductor attachment point from centre of tower In M	Approx. Width of right of way in M	AS per the current standards IS5613/CBIP in Mtrs	Proposed RoW value for compensation	Reduction in RoW	Proposed base width of tower for Compensation
A		B		C		X	R=2(D+H)+2X		X	R				
±800kV HVDC	Horizontal	ACSR Lapwing	Plain/Forest/ Urban	400	"Y" String	X	**44.4**	**2X**	12.3	69	69	69	0	21
±500kV HVDC	Horizontal	ACSR Lapwing	Plain/Forest/ Urban	400	"V" String	X	**31.8**	**2X**	8.2	48	52	48	4	17
400kV D/C & S/C	Vertical	ACSR MOOSE	Plain	400	"I" String	X	**31**	**2X**	7.5	**46**	**46**	**46**	**0**	**17**
					"V" String	X	**26.4**	**2X**	6.0	**38**				
					Tension		**26.4**	**2X**	9.7	**46**				
			Forest	300	"I" String	X	**25.2**	**2X**	7.5	**40**				
					"V" String	X	**20.6**	**2X**	6.0	**33**	**46**	**40**	**6**	**17**
					Tension		**20.6**	**2X**	9.7	**40**				
			Urban	250	"I" String	X	**22.8**	**2X**	7.5	**38**				
					"V" String	X	**18.2**	**2X**	6.0	**30**	**46**	**38**	**8**	**17**
					Tension		**18.2**	**2X**	9.7	**38**				
400kV S/C	Horizontal	ACSR MOOSE	Plain	400	"I" String	X	**31**	**2X**	10.9	**53**	**52**	**53**	**-1**	**17**
					"V" String	X	**26.4**	**2X**	9.1	**45**				
					Tension		**26.4**	**2X**	13.5	**53**				
			Forest	300	"I" String	X	**25.2**	**2X**	10.9	**47**				
					"V" String	X	**20.6**	**2X**	9.1	**39**	**52**	**48**	**4**	**17**
					Tension		**20.6**	**2X**	13.5	**48**				
			Urban	250	"I" String	X	**22.8**	**2X**	10.9	**45**				
					"V" String	X	**18.2**	**2X**	9.1	**36**	**52**	**45**	**7**	**17**
					Tension		**18.2**	**2X**	13.5	**45**				
1200kV	Horizontal	ACSR Moose	Plain/Forest/ Urban	400	"V" String	X	**41.2**	**2X**	24	89	89	89	0	18

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RIGHT OF WAY CALCULATION PLAIN/FOREST & URBAN

Voltage level	Configuration	Conductor type	Terrain	Ruling Span	String Type	Horizontal distance of Conductor attachment point from centre of tower In M	Width of right of way in M		Tentative Horizontal distance of Conductor attachment point from centre of tower In M	Approx. Width of right of way in M	AS per the current standards IS5613/CBIP in Mtrs	Proposed RoW value for compensation	Reduction in RoW	Proposed base width of tower for Compensation
A		B		C		X	R=2(D+H)+2X		X	R				
220kV D/C	Vertical	ACSR ZEBRA	Plain	350	"I" String	X	22.6	2X	4.6	32	35	32	3	12
					"V" String	X	19.8	2X	4	28				
					Tension		19.8	2X	5.7	31				
			Forest	300	"I" String	X	19.8	2X	4.6	29				
					"V" String	X	17	2X	4	25	35	28	7	12
					Tension		17	2X	5.7	28				
			Urban	200	"I" String	X	15.4	2X	4.6	25				
					"V" String	X	12.6	2X	4	21	35	24	11	12
					Tension		12.6	2X	5.7	24				
132kV D/C	Vertical	ACSR PANTHER	Plain	320	"I" String	X	17	2X	3.9	25	27	25	2	9
					"V" String	X	14.4	2X	3.5	21				
					Tension		14.4	2X	5.3	25				
			Forest	200	"I" String	X	12.6	2X	3.9	20				
					"V" String	X	10	2X	3.5	17	27	21	6	9
					Tension		10	2X	5.3	21				
			Urban	150	"I" String	X	11	2X	3.9	19				
					"V" String	X	8.4	2X	3.5	15	27	19	8	9
					Tension		8.4	2X	5.3	19				

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RIGHT OF WAY CALCULATION PLAIN/FOREST & URBAN

Voltage level	Configuration	Conductor type	Terrain	Ruling Span	String Type	Horizontal distance of Conductor attachment point from centre of tower In M	Width of right of way in M		Tentative Horizontal distance of Conductor attachment point from centre of tower In M	Approx. Width of right of way in M	AS per the current standards IS5613/CBIP in Mtrs	Proposed RoW value for compensation	Reduction in RoW	Proposed base width of tower for Compensation
A		B		C		X	R=2(D+H)+2X		X	R				
66kV	Vertical	ACSR PANTHER	Plain	250	"I" String	X	12.5	2X	2.5	18	18	18	0	7
					"V" String	X	10.4	2X	2.5	15				
					Tension		10.4	2X	3.5	17				
			Forest	150	"I" String	X	9.4	2X	2.5	14				
					"V" String	X	7.3	2X	2.5	12	18	14	4	7
					Tension		7.3	2X	3.5	14				
			Urban	100	"I" String	X	8.3	2X	2.5	13				
					"V" String	X	6.1	2X	2.5	11	18	13	5	7
					Tension		6.1	2X	3.5	13				
66kV		ACSR DOG	Plain	250	"I" String	X	14	2X	2.5	19	18	19	-1	7
					"V" String	X	11.8	2X	2.5	17				
					Tension		11.8	2X	3.5	19				
			Forest	150	"I" String	X	10.2	2X	2.5	15				
					"V" String	X	8	2X	2.5	13	18	15	3	7
					Tension		8	2X	3.5	15				
			Urban	100	"I" String	X	8.8	2X	2.5	14				
					"V" String	X	6.6	2X	2.5	12	18	14	4	7
					Tension		6.6	2X	3.5	14				

Detailed Calculation Sheet

RIGHT OF WAY CALCULATION

Voltage level	Configuration	Conductor type	Ruling Span	String Type	Horizontal clearance in M (2.0m+0.3 M for each additional 33 kV)	Insulator Length (Considered for Swing) in M	Max Sag at 85 Deg.C in M	Max Swing angle In Deg	Horizontal displacement from Conductor attachment point due to swing.	Horizontal distance of Conductor attachment point from centre of tower In M	**Width of right of way in M**	Tentative Tower width	Tentative Horizontal distance of Conductor attachment point from centre of tower In M	Approx. Width of right of way in M
A		**B**	**C**		**D**	**E**	**F**	**G**	**H=(E+F) *Sin35**	**X**	**R=2(D+H) +2X**		**X**	**R**
765kV	Vertical	ACSR ZEBRA	400	"I" String	9.0	7.6	13.3	35	12.0	X	**42+2X**	6.5	12.5	67
				"V" String	9.0	0	13.3	35	7.6	X	**33.2+2X**	6.5	10.5	54
			300	"I" String	9.0	7.6	8.2	35	9.1	X	**36+2X**	6.5	12.5	61
				"V" String	9.0	0	8.2	35	4.7	X	**27+2X**	6.5	10.5	48
			250	"I" String	9.0	7.6	6.1	35	7.9	X	**34+2X**	6.5	12.5	59
				"V" String	9.0	0	6.1	35	3.5	X	**25+2X**	6.5	10.5	46
			200	"I" String	9.0	7.6	4.3	35	6.8	X	**32+2X**	6.5	12.5	57
				"V" String	9.0	0	4.3	35	2.5	X	**23+2X**	6.5	10.5	44
			150	"I" String	9.0	7.6	2.8	35	6.0	X	**30+2X**	6.5	12.5	55
				"V" String	9.0	0	2.8	35	1.6	X	**21+2X**	6.5	10.5	42

765kV	Vertical /Delta	ACSR BERSIMIS	400	"I" String	9.0	7.1	14.8	35	12.6	X	**43.2+2X**	8.04	10.5	64
				"V" String	9.0	0	14.8	35	8.5	X	**35+2X**	8.04	9.5	54
			300	"I" String	9.0	7.1	9.1	35	9.3	X	**36.6+2X**	8.04	10.5	58
				"V" String	9.0	0	9.1	35	5.2	X	**28.4+2X**	8.04	9.5	47
			250	"I" String	9.0	7.1	6.8	35	8.0	X	**34+2X**	8.04	10.5	55
				"V" String	9.0	0	6.8	35	3.9	X	**25.8+2X**	8.04	9.5	45
			200	"I" String	9.0	7.1	4.8	35	6.8	X	**31.6+2X**	8.04	10.5	53
				"V" String	9.0	0	4.8	35	2.8	X	**23.6+2X**	8.04	9.5	43
			150	"I" String	9.0	7.1	3.1	35	5.9	X	**29.8+2X**	8.04	10.5	51
				"V" String	9.0	0	3.1	35	1.8	X	**21.6+2X**	8.04	9.5	41

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RIGHT OF WAY CALCULATION

Voltage level	Configuration	Conductor type	Ruling Span	String Type	Horizontal clearance in M (2.0m+0.3 M for each additional 33 kV)	Insulator Length (Considered for Swing) in M	Max Sag at 85 Deg.C in M	Max Swing angle In Deg	Horizontal displacement from Conductor attachment point due to swing.	Horizontal distance of Conductor attachment point from centre of tower In M	**Width of right of way in M**	Tentative Tower width	Tentative Horizontal distance of Conductor attachment point from centre of tower In M	Approx. Width of right of way in M
A		**B**	**C**		**D**	**E**	**F**	**G**	**H=(E+F) *Sin35**	**X**	**R=2(D+H) +2X**		**X**	**R**
765kV	Horizontal	ACSR BERSIMIS	400	"I" String	9.0	7.1	14.8	35	12.6	X	**43.2+2X**		15.6	74
				"V" String	9.0	0	14.8	35	8.5	X	**35+2X**		14.4	64
			300	"I" String	9.0	7.1	9.1	35	9.3	X	**36.6+2X**		15.6	68
				"V" String	9.0	0	9.1	35	5.2	X	**28.4+2X**		14.4	57
			250	"I" String	9.0	7.1	6.8	35	8.0	X	**34+2X**		15.6	65
				"V" String	9.0	0	6.8	35	3.9	X	**25.8+2X**		14.4	55
			200	"I" String	9.0	7.1	4.8	35	6.8	X	**31.6+2X**		15.6	63
				"V" String	9.0	0	4.8	35	2.8	X	**23.6+2X**		14.4	52
			150	"I" String	9.0	7.1	3.1	35	5.9	X	**29.8+2X**		15.6	61
				"V" String	9.0	0	3.1	35	1.8	X	**21.6+2X**		14.4	50
±800kV HVDC	Horizontal	ACSR Lapwing	400	"Y" String	10.6	5.3	14.9	35	11.6	X	**44.4+2X**		12.3	69
			300	"Y" String	10.6	5.3	9.2	35	8.3	X	**37.8+2X**		12.3	62
			250	"Y" String	10.6	5.3	6.9	35	7.0	X	**35.2+2X**		12.3	60
			200	"Y" String	10.6	5.3	4.9	35	5.9	X	**33+2X**		12.3	58
			150	"Y" String	10.6	5.3	3.2	35	4.9	X	**31+2X**		12.3	56
±500kV HVDC	Horizontal	ACSR Lapwing	400	"V" String	7.4	0	14.9	35	8.5	X	**31.8+2X**		8.2	48
			300	"V" String	7.4	0	9.2	35	5.3	X	**25.4+2X**		8.2	42
			250	"V" String	7.4	0	6.9	35	4.0	X	**22.8+2X**		8.2	39
			200	"V" String	7.4	0	4.9	35	2.8	X	**20.4+2X**		8.2	37
			150	"V" String	7.4	0	3.2	35	1.8	X	**18.4+2X**		8.2	35

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RIGHT OF WAY CALCULATION

Voltage level	Configuration	Conductor type	Ruling Span	String Type	Horizontal clearance in M (2.0m+0.3 M for each additional 33 kV)	Insulator Length (Considered for Swing) in M	Max Sag at 85 Deg.C in M	Max Swing angle In Deg	Horizontal displacement from Conductor attachment point due to swing.	Horizontal distance of Conductor attachment point from centre of tower In M	**Width of right of way in M**	Tentative Tower width	Tentative Horizontal distance of Conductor attachment point from centre of tower In M	Approx. Width of right of way in M
A		**B**	**C**		**D**	**E**	**F**	**G**	**H=(E+F) *Sin35**	**X**	**R=2(D+H) +2X**		**X**	**R**
400kV	Vertical	ACSR MOOSE	400	"I" String	5.6	4.0	13.3	35	9.9	X	**31+2X**	3.75	7.5	46
				"V" String	5.6	0	13.3	35	7.6	X	**26.4+2X**	3.75	6.0	38
			300	"I" String	5.6	4.0	8.2	35	7.0	X	**25.2+2X**	3.75	7.5	40
				"V" String	5.6	0	8.2	35	4.7	X	**20.6+2X**	3.75	6.0	33
			250	"I" String	5.6	4.0	6.1	35	5.8	X	**22.8+2X**	3.75	7.5	38
				"V" String	5.6	0	6.1	35	3.5	X	**18.2+2X**	3.75	6.0	30
			200	"I" String	5.6	4.0	4.3	35	4.8	X	**20.8+2X**	3.75	7.5	36
				"V" String	5.6	0	4.3	35	2.5	X	**16.2+2X**	3.75	6.0	28
			150	"I" String	5.6	4.0	2.8	35	3.9	X	**19+2X**	3.75	7.5	34
				"V" String	5.6	0	2.8	35	1.6	X	**14.4+2X**	3.75	6.0	26
400kV	Vertical	ACSR BERSIMIS	400	"I" String	5.6	4.0	14.8	35	10.8	X	**32.8+2X**	3.75	7.5	48
				"V" String	5.6	0	14.8	35	8.5	X	**28.2+2X**	3.75	6.0	40
			300	"I" String	5.6	4.0	9.1	35	7.5	X	**26.2+2X**	3.75	7.5	41
				"V" String	5.6	0	9.1	35	5.2	X	**21.6+2X**	3.75	6.0	34
			250	"I" String	5.6	4.0	6.8	35	6.2	X	**23.6+2X**	3.75	7.5	39
				"V" String	5.6	0	6.8	35	3.9	X	**19+2X**	3.75	6.0	31
			200	"I" String	5.6	4.0	4.8	35	5.0	X	**21.2+2X**	3.75	7.5	36
				"V" String	5.6	0	4.8	35	2.8	X	**16.8+2X**	3.75	6.0	29
			150	"I" String	5.6	4.0	3.1	35	4.1	X	**19.4+2X**	3.75	7.5	34
				"V" String	5.6	0	3.1	35	1.8	X	**14.8+2X**	3.75	6.0	27

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RIGHT OF WAY CALCULATION

Voltage level	Configuration	Conductor type	Ruling Span	String Type	Horizontal clearance in M (2.0m+0.3 M for each additional 33 kV)	Insulator Length (Considered for Swing) in M	Max Sag at 85 Deg.C in M	Max Swing angle In Deg	Horizontal displacement from Conductor attachment point due to swing.	Horizontal distance of Conductor attachment point from centre of tower In M	**Width of right of way in M**	Tentative Tower width	Tentative Horizontal distance of Conductor attachment point from centre of tower In M	Approx. Width of right of way in M
A		**B**	**C**		**D**	**E**	**F**	**G**	**H=(E+F) *Sin35**	**X**	**R=2(D+H) +2X**		**X**	**R**
400kV	Horizontal	ACSR MOOSE	400	"I" String	5.6	4.0	13.3	35	9.9	X	**31+2X**		10.9	53
				"V" String	5.6	0	13.3	35	7.6	X	**26.4+2X**		9.1	45
			300	"I" String	5.6	4.0	8.2	35	7.0	X	**25.2+2X**		10.9	47
				"V" String	5.6	0	8.2	35	4.7	X	**20.6+2X**		9.1	39
			250	"I" String	5.6	4.0	6.1	35	5.8	X	**22.8+2X**		10.9	45
				"V" String	5.6	0	6.1	35	3.5	X	**18.2+2X**		9.1	36
			200	"I" String	5.6	4.0	4.3	35	4.8	X	**20.8+2X**		10.9	43
				"V" String	5.6	0	4.3	35	2.5	X	**16.2+2X**		9.1	34
			150	"I" String	5.6	4.0	2.8	35	3.9	X	**19+2X**		10.9	41
				"V" String	5.6	0	2.8	35	1.6	X	**14.4+2X**		9.1	33
400kV upgradeable to 1200kV	Horizontal	ACSR Moose	400	"V" String	13.0	0	13.3	35	7.6	X	**41.2+2X**		24	89
			300	"V" String	13.0	0	8.2	35	4.7	X	**35.4+2X**		24	83
			250	"V" String	13.0	0	6.1	35	3.5	X	**33+2X**		24	81
			200	"V" String	13.0	0	4.3	35	2.5	X	**31+2X**		24	79
			150	"V" String	13.0	0	2.8	35	1.6	X	**29.2+2X**		24	77
220kV	Vertical	ACSR ZEBRA	350	"I" String	3.8	2.5	10.6	35	7.5	X	**22.6+2X**	1.9	4.6	32
			300	"I" String	3.8	2.5	8.2	35	6.1	X	**19.8+2X**	1.9	4.6	29
			250	"I" String	3.8	2.5	6.1	35	4.9	X	**17.4+2X**	1.9	4.6	27
			200	"I" String	3.8	2.5	4.3	35	3.9	X	**15.4+2X**	1.9	4.6	25
			150	"I" String	3.8	2.5	2.8	35	3.0	X	**13.6+2X**	1.9	4.6	23

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Voltage level	Configuration	Conductor type	Ruling Span	String Type	Horizontal clearance in M (2.0m+0.3 M for each additional 33 kV)	Insulator Length (Considered for Swing) in M	Max Sag at 85 Deg.C in M	Max Swing angle In Deg	Horizontal displacement from Conductor attachment point due to swing.	Horizontal distance of Conductor attachment point from centre of tower In M	**Width of right of way in M**	Tentative Tower width	Tentative Horizontal distance of Conductor attachment point from centre of tower In M	Approx. Width of right of way in M
A		**B**	**C**		**D**	**E**	**F**	**G**	**H=(E+F) *Sin35**	**X**	**R=2(D+H) +2X**		**X**	**R**
132kV	Vertical	ACSR PANTHER	320	"I" String	2.9	2.3	7.5	35	5.6	X	**17+2X**	1.6	3.9	25
			200	"I" String	2.9	2.3	3.6	35	3.4	X	**12.6+2X**	1.6	3.9	20
			150	"I" String	2.9	2.3	2.3	35	2.6	X	**11+2X**	1.6	3.9	19
			100	"I" String	2.9	2.3	1.3	35	2.1	X	**10+2X**	1.6	3.9	18
66kV		ACSR WOLF	250	"I" String	2.3	1.9	5.8	35	4.4	X	**13.4+2X**	1.2	2.5	18
			150	"I" String	2.3	1.9	2.7	35	2.6	X	**9.8+2X**	1.2	2.5	15
			100	"I" String	2.3	1.9	1.5	35	2.0	X	**8.6+2X**	1.2	2.5	14
66kV		ACSR DOG	250	"I" String	2.3	1.9	6.3	35	4.7	X	**14+2X**	1.2	2.5	19
			150	"I" String	2.3	1.9	2.9	35	2.8	X	**10.2+2X**	1.2	2.5	15
			100	"I" String	2.3	1.9	1.7	35	2.1	X	**8.8+2X**	1.2	2.5	14
66kV		ACSR Panther	250	"I" String	2.3	1.9	5	35	4.0	X	**12.5+2X**	1.2	2.5	18
			150	"I" String	2.3	1.9	2.3	35	2.4	X	**9.4+2X**	1.2	2.5	14
			100	"I" String	2.3	1.9	1.3	35	1.8	X	**8.3+2X**	1.2	2.5	13

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Diagram for I String

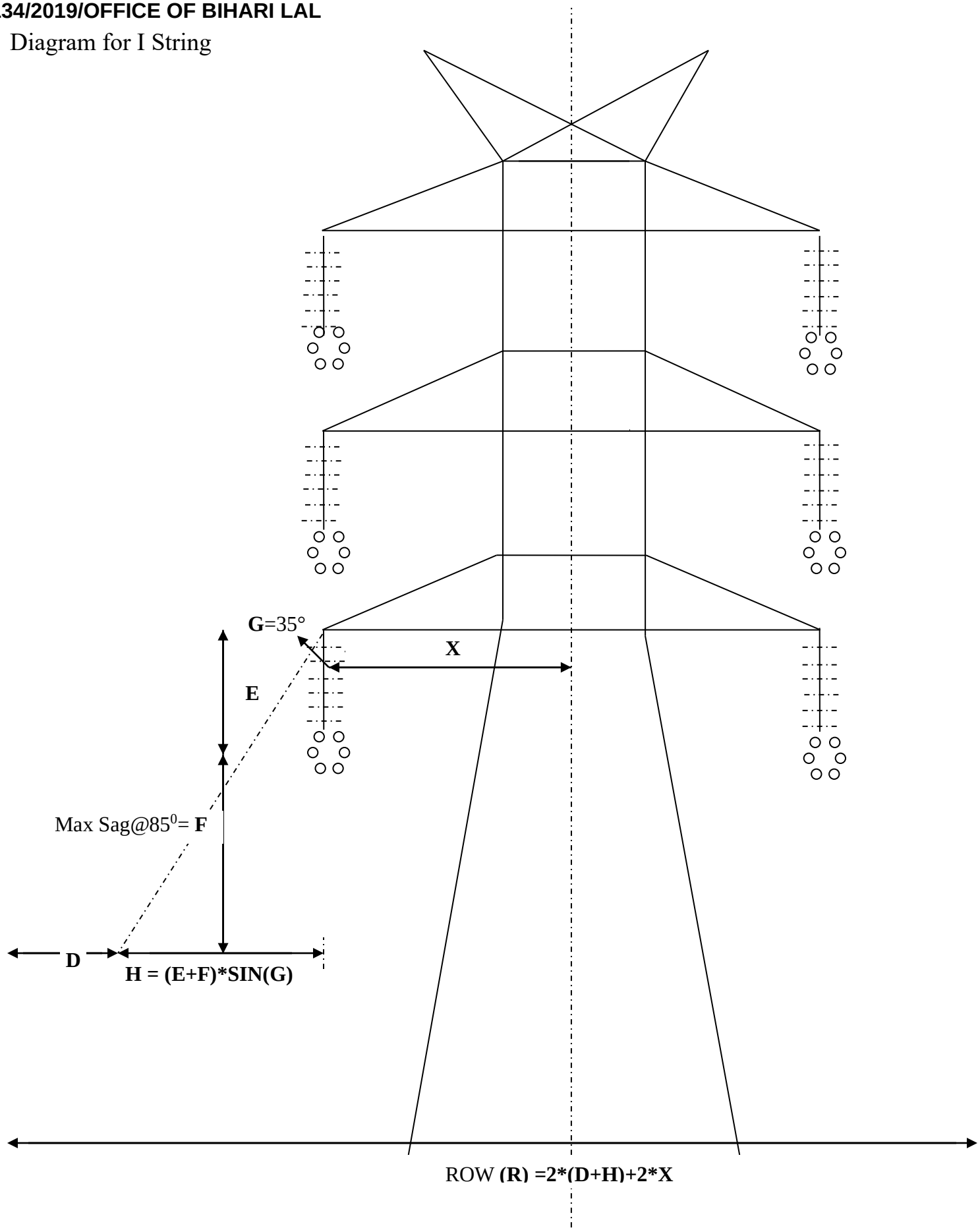

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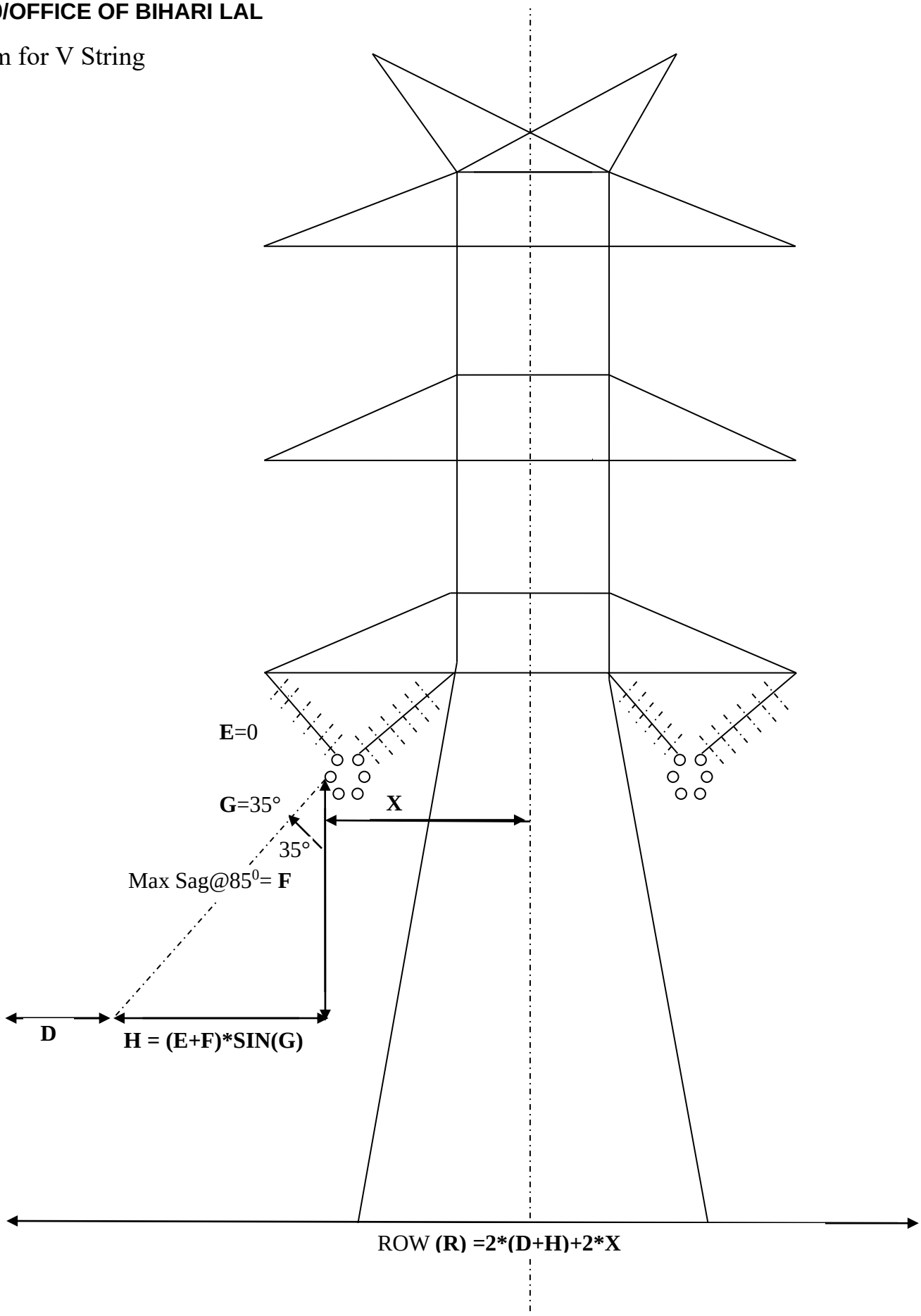
Diagram for V String



Appendix-VII

Minutes of the 5th meeting of the Committee Chaired by Ms. Shalini Prasad, Additional Secretary, Ministry of Power (MoP) on 08-02-2017 for finalization of compensation in regard to Right of Way (RoW) for Transmission line falling in urban areas.

List of Participants is at **Annex – 1**.

2. Additional Secretary, MoP welcomed the participants and emphasised on the need to expeditiously finalise the report of the Committee.

3. On deliberation with the representative of the Town & Country Planning Organisation, it was decided that Ministry of Power (MoP) will write to Ministry of Urban Development to take up the issue of providing a dedicated corridor for the interstate and intra-state transmission lines and space for establishment of substations in all green field and brown field projects at the planning stage itself with State Governments/ State Urban development authorities. In this regard, State Governments/ State Urban development authorities may consult with State Transmission Utility/ CTU.

4. CEA informed that the owners of the land coming under the RoW are prohibited from any construction activity under the transmission line due to safety reasons. Since the main use of the land in the rural areas is for the purpose of agriculture, the land under RoW can still be used for the agriculture purpose. However, in urban areas, the value of land under RoW diminishes rapidly. Therefore, in the notified urban areas, the compensation of the land coming under the RoW should have an additional component in the form of non-usability allowance to be paid to the owners. The value of non-usability allowance is proposed to be at 15% of the land value for the width of RoW corridor. This non-usability allowance is in addition to the 15% compensation already agreed towards the diminution of the land value falling in the RoW of the transmission line. The payment of non-usability allowance is subject to the condition that no construction activities would be permitted in the RoW area.

5. Representative from PGCIL stated that the increase in compensation of urban areas may raise the issue of dispute between rural and urban population and ministry being biased against the rural areas.

6. Representative from Karnataka stated that the landowners in urban areas may also be allowed construction up to a certain height coming under the RoW of transmission lines and for providing the requisite safety clearances, height of towers may be increased. The same practice is used in many foreign countries

such as Japan etc. He added that if construction activities are allowed under RoW, utilities may face lesser problem in acquiring RoW from landowners and chances of litigation may also get reduced. Non-residential activities like godowns, cold storage etc. may be permitted under the transmission lines. Chief Engineer (PSE&TD, CEA) stated that the construction activities under the RoW should not be allowed in urban areas because in case of a tower failure/ snapping of conductor the lives of persons living under Row would be in danger. Moreover, in current scenario, even when no construction is allowed, there are instances of unauthorized constructions under the RoW. If construction activities are permitted under RoW, then there is a possibility that unauthorized construction may increase manifold thus endangering lives of persons living under the RoW. Representative from PGCIL stated that allowing construction activities under the RoW would increase the height of tower thereby increasing the cost of transmission line considerably. The transmission line with extended tower may become costlier than the current method adopted by utilities i.e. to pay the compensation.

7. Director (PSP&A-I), CEA stated that if construction activities are allowed under the RoW of the transmission line, then transmission utilities may face difficulty in carrying out the O&M activities as accessibility to the transmission line would become difficult.

8. Additional Secretary, MoP stated that allowing the non- residential activities can be looked as a solution to the problem and state governments may be asked to make an advisory body for regulating the same. This will also help in conversion of residential building to commercial building. Chief Engineer (PSE&TD, CEA) stated that present safety regulations of CEA do not allow any type of construction activities under RoW of the Transmission line. Further, Chief Engineer (Electrical Inspectorate, CEA) need to be consulted for allowing non-residential activities under the RoW of transmission line.

9. Representative from PGCIL stated that the land use of the city changes with time and a new master plan generally comes in 5 years. The amount to be paid as non-usability allowance may be kept limited to the notified urban area. Additional Secretary, MoP stated that this allowance shall be paid only in cases where no further construction activity is allowed in the RoW land.

10. Regarding the sub-committee constituted for determining RoW requirements at 33 kV voltage level, CEA informed that the first meeting of the sub-committee was held on 02.02.2017 wherein it was decided that a format would be circulated by CEA to all the members of the committee. The format would include various conductors, different span, line configurations etc at 33 kV level for calculation of RoW. Based on the calculations submitted by the members RoW matrix for 33 kV voltage level, would be prepared by CEA and the same would be

finalized in the second meeting of the sub-committee. The format has already been circulated by CEA and inputs from the members are awaited.

11. After further discussions, following decisions were taken:

(i) Additional compensation in the form of non-usability allowance of 15% of the land value for the width of RoW corridor would be applicable in the notified urban areas. No construction activity of any kind would be permitted under the RoW of the transmission line.

(ii) The RoW for 33 kV transmission lines as finalized by sub-committee for the purpose would be included in the draft report of the Committee on RoW compensation for urban areas and the same would be circulated to members of the committee for their comments.

(iii) After receipt of the comments from the members of the committee, the final report of the committee would be issued.

(iv) Chief Electrical Inspectorate, CEA would initiate/ circulate a discussion paper allowing construction activity under the RoW of the transmission line.

12. The meeting concluded with thanks to the Chair.

Annex-1
No. 3/4/2016-Trans

Date/ time of the meeting: 8.2.2017 at 3.30 pm
Venue: Ministry of Power, Conference Room
Shram Shakti Bhawan, New Delhi-110001

List of Participants

Ministry of Power

16. Ms. Shalini Prasad, Additional Secretary (SP) - In the Chair
17. Smt. Jyoti Arora, Joint Secretary (Trans)
18. Shri Irfan Ahmad, Director (Trans)

Central Electricity Authority (CEA)

19. Shri Ravinder Gupta, Chief Engineer,
    Mobile: 9968286184, Email: ravindergupta_cea@rediffmail.com
20. Shri S.K. Ray Mohapatra, Chief Engineer,
    Mobile: 9818527857, Email: skmohapatra@rediffmail.com
21. Shri Awadesh Yadav, Director (PSPA-I)
    Phone : 011-26732318/Mob:9868664087/Email : awd.cea@gmail.com
22. Shri Mohit Mudgal, Assistant Director–I
    Mobile: 9873454092, Email: mohitmudgal20@gmail.com

Power Grid Corporation Of India Limited (PGCIL)

23. Shri Atul Trivedi, E.D.,
    Mobile: 9873549029, 0124-2571980, Email: atul.trivedi@powergridindia.com
24. Shri A.K. Vyas, Addl. GM,
    Mobile: 9910378107, Email: akvyas@powergridindia.com
25. Dr. R.K. Srivastava, Addl. GM,
    Mobile: 9910378134, Email: rks@powergridindia.com

Govt. of Uttar Pradesh/UPPTCL

26. Shri Ravi Prakash Dubey, Chief Engineer (Transmission West),
    Mobile: 9412749801, Email: director_project@upptcl.org,cetw@upptcl.org
27. Shri Yatendra Kumar, SE (Trans), Gzb.
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Govt. of Haryana/HVPN

28. Shri Rajesh Sharma, XEN,
    Mobile: 9315353640, Email: xentsggn@gmail.com

Govt. of Kerala/KSEBL

29. Smt. Vijayakumari. P, Director (Trans. & SO)
    Mobile: 9446008444, Email: mtkseb@ksebnet.com
30. Smt. Sheela M Daniel, Resident Engineer,
    Mobile: 9599096599, 23381964, Email: ksebdelhi@gmail.com

Govt. of Maharashtra/MAHATRANSCO

31. Shri Charuta Be ndre, Superintending Engineer,
    Mobile: 9822076434, 022-26595165, Email: se3prj@mahatransco.in

Govt. of Karnataka/KPTCL

32. Shri P. Ravi Kumar, Secretary,
    Mobile: 9448124242, Email: prs-energy@karnataka.gov.in
33. Shri Deepak T.C. Resident Engineer,
    Mobile: 9717695244, Email: deepaktc23@gmail.com

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TCPO, MOUD

34. Shri Monis Khan,
    Mobile: 9818158485, Email: khanmonis@yahoo.com
35. Shri S. Sompalle,
    Mobile: 9968249396, Email: ssompalle@yahoo.co.in

Appendix VIII

Report of the Committee for finalization of Right of Way (RoW) for 33 kV Transmission lines

16.1 **Background**

1.5 The matter of Right of Way for laying of transmission lines in the country was deliberated during the Power Ministers' Conference on 9-10 April 2015 at Guwahati and a committee under the Chairmanship of Special Secretary, Ministry of Power was constituted to analyse the issues related to Right of Way for laying of transmission lines in the country and to suggest a uniform methodology for payment of compensation on this account. The committee comprised of Chairperson, CEA, Principal Secretary (Energy) of M.P., U.P, Maharashtra, Karnataka, Kerala, Jt. Secretary (Trans), MoP, CMD/Dir (Projects), POWERGRID and Chief Engineer (SP&PA), CEA as convener and Member Secretary.

1.6 The Committee met three times (20.04.2015, 30.04.2015 and 1.06.2015) before finalizing its recommendations. The committee finalized its recommendations for payment of compensation towards damages in regard to Right of Way for transmission lines, which was issued via MoP OM No. 3/7/2015-Trans dated 15th October, 2015. The guidelines are applicable only for transmission lines of 66 kV and above voltage level. The guidelines recommended compensation for 85% of the land value for tower footing and 15% of the land value for RoW of the line. The above guidelines were communicated by the Ministry of Power to Chief Secretaries of all the States with the request to take suitable decision regarding adoption of the guidelines considering that acquisition of land is a state subject.

1.7 Further, to analyze the issues related to RoW for laying of transmission lines in the urban areas of the country and to suggest a methodology for payment of compensation on this account, a committee under the chairmanship of Ms. Shalini Prasad, Additional Secretary, Ministry of Power with members from CEA, Principal Secretary (Energy) of M.P., U.P, Maharashtra, Karnataka, Kerala, POWERGRID has been constituted. The terms of reference of the committee, inter alia, includes "Review/Analysis of existing procedures for compensation"

1.8 Four meetings of the committee were held in MoP on 30.8.2016, 30.9.2016, 2.11.2016 and 8.12.2016. In the 4th meeting of the committee, the representations received from Small Hydro Power developers for reduction of RoW at 33 kV voltage level and the incidents of death of elephants in forest areas due to electrocution was highlighted and accordingly, it was decided to constitute a sub-committee to look into the issue of RoW requirement for 33 kV transmission lines.

16.2 **Constitution and term of reference of the committee for RoW for 33 kV**

2.1 MoP vide its OM dated 20.1.2017 (copy enclosed at **Annexure-I**) constituted the committee under the chairmanship of Chief Engineer, PSPA-I, CEA alongwith representatives from CEA, Punjab, Uttarakhand, Himachal Pradesh, TATA Power and other stakeholders. The MoP order also provided for invitation to representatives from small Hydro developer / other utilities. Subsequently, MoP vide its letter dated 13-02-2017 included Chief Engineer CEI, CEA as a member of the committee.

2.2 To deliberate and finalise the Right of Way (RoW) requirements for lines at 33 kV level.

3 Deliberations of the committee of RoW requirement for 33 kV transmission lines

3.1 1st meeting of the committee was held on 2.2.2107 at CEA, New Delhi, wherein all the committee members and representatives from Himalayan Power Producers Association (on behalf of Small Hydro developers) participated.

3.2 In the meeting, it was decided that CEA will circulate a matrix listing down the combination of type of conductors, tower configuration, design span and type of insulator to all the members of the committee for calculating RoW for 33 kV transmission line.

3.3 The minutes of the 1st meeting is enclosed at **Annexure-1I.**

3.4 Subsequently, MoP convened a meeting on 8.2.2017, wherein CEA was requested to circulate the draft report **for finalisation of compensation in regard to Right of Way (RoW) for transmission lines in urban areas** after including the recommendations of the committee constituted for finalization of RoW for 33kV voltage level.

3.5 The 2nd meeting of the committee was held on 24.03.2107 at CEA, New Delhi, wherein, the RoW requirement for 33 kV voltage level was finalised. The minutes of the 2nd meeting of the committee is enclosed at Annexure-III.

The minutes of meeting is enclosed at **Annexure-III**

4 Recommendations of the Committee.

i) The RoW width for (a) 33kV overhead transmission lines for different types of structures, commonly used ACSR conductor (with maximum operating temperature of 85 degree) & normal design span and (b) for 33kV lines with covered conductor mounted on pole type structure shall be as indicated below.

33 kV RoW requirement for various configuration

Conductor	Structure Type	Design Span (in m)	String Type	**RoW recommended (in m)**
Commonly used ACSR Bare conductor	Lattice type/ Steel Monopole	250	"I" String/Suspension	15 meter
			Tension	
		150	"I" String/Suspension	12 meter
			Tension	
	(Concrete Pole/Rail pole/H pole/ Single steel pole)	100	Pin Insulator	9 meter
		60	Pin Insulator	8 meter
Covered	Pole	100		6 meter

ii) The CEA Safety Regulations, 2010 are under revision, wherein it has been proposed that in case of transmission lines of 33 kV and below voltage level passing through National Parks, Wildlife Sanctuaries and Wildlife Corridors, underground cables or overhead insulated (covered) conductors shall only be used to prevent accidental death of animals due to electrocution. The RoW width of 6m recommended for 33kV transmission lines with covered conductors mounted on Pole type structure would be further looked into, if required, as and when amendments in Safety regulations, 2010 will come into effect.

iii) These recommendations would form part of the main report of the Committee finalizing compensation in regard to Right of Way for transmission line falling in urban areas.

iv) The possibility of reduction in minimum safe horizontal clearance of 2m, and reduction in the RoW width for 33kV lines with covered conductors mounted on Pole type structure would be deliberated further while bringing out the revision of (Measures relating to Safety and Electric Supply) Regulations.

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Annexure-I

No. 3/4/2016-Trans
Government of India
Ministry of Power
Shram Shakti Bhawan, Rafi Marg, New Delhi- 110001

Dated, 20th January, 2017

OFFICE MEMORANDUM

Subject:- Constitution of the Committee to deliberate and finalise Right of Way (RoW) requirements for transmission lines at 33 kV level.

The undersigned is directed to state that during the fourth meeting of the committee regarding finalization of compensation in regard to RoW for transmission lines falling in urban areas, held on 8.12.2016 under theChairpersonship of Ms. Shalini Prasad, Additional Secretary, Ministry of Power, it has *inter alia* been decided to constitute a Committee comprising representatives from CEA, Govt. of Punjab/ Uttarakhand/ Himachal Pradesh/ Tata Power etc., to deliberate and finalise Right of Way (RoW) requirements for transmission lines at 33 kV level.

2. Accordingly, a Committee is hereby constituted with the following composition:-

1 Chief Engineer, PSP&PA-I, CEA - Chairperson
2 Chief Engineer, DPD, CEA
3 Chief Engineer, PSETD, CEA
4 Representative of Govt. of Punjab
5 Representative of Govt. of Uttarakhand
6 Representative of Govt. of Himachal Pradesh
7 Representative of Tata Power

3. The Committee, if required, may invite representatives from Small Hydro Power developers/ other utilities to its meeting(s).

4. The Committee shall submit its report in the next meeting of the Urban RoW Committee, which is scheduled for 3.2.2017 at 3.00 pm.

20/1/17

(Bihari Lal)
Under Secretary to the Govt. of India
Tele: 011-23325242
Email: transdesk-mop@nic.in

24.01.17

To,

1 Member (PS), Central Electricity Authority
2 Principal Secretary/ Secretary (Energy), Govt. of Punjab
3 Principal Secretary/ Secretary (Energy), Govt. of Uttarakhand
4 Principal Secretary/ Secretary (Energy), Govt. of Himachal Pradesh
5 Chief Engineer, PSP&PA-I, CEA, New Delhi.
6 Chief Engineer, DPD, CEA
7 Chief Engineer, PSETD, CEA
8 MD, Tata Power, Mumbai

CE (PAI)

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No. 3/4/2016-Trans
Government of India
Ministry of Power
Shram Shakti Bhawan, Rafi Marg, New Delhi- 110001

Dated, 13th February, 2017

OFFICE MEMORANDUM

Subject:- Constitution of the Committee to deliberate and finalise Right of Way (RoW) requirements for transmission lines at 33 kV level.

In continuation of this Ministry's O.M. of even No. dated 20.01.2017, the undersigned is directed to say that Chief Engineer, CEI(CEA) will also be part of the Committee to deliberate and finalise Right of Way (RoW) requirements for transmission lines at 33 kV level.

2. All other terms and conditions of the said OM remain un-changed.

18/2/17

(Bihari Lal)
Under Secretary to the Govt. of India
Tele: 011-23325242
Email: transdesk-mop@nic.in

To,

1 Member (PS), Central Electricity Authority
2 Principal Secretary/ Secretary (Energy), Govt. of Punjab
3 Principal Secretary/ Secretary (Energy), Govt. of Uttarakhand
4 Principal Secretary/ Secretary (Energy), Govt. of Himachal Pradesh
5 Chief Engineer, PSP&PA-I, CEA, New Delhi.
6 Chief Engineer, DPD, CEA
7 Chief Engineer, PSETD, CEA
8 Chief Engineer, CEI, CEA
9 MD, Tata Power, Mumbai

Sh. Pradhan 1.2.17

Annexure-II

Minutes of the meeting of the committee to deliberate and finalize RoW requirements for transmission lines at 33kV held on 2.2.2017 at CEA

List of Participants is at Annex-I

1. Chief Engineer (PSPA-I) welcomed the participants and stated that in the 4th meeting of the Committee to finalize compensation in regard to Right of Way for transmission line falling in urban areas held at MoP on 8.12.2016, it was, interalia, decided to constitute a sub-committee, which would deliberate and finalise RoW requirements for 33 kV transmission lines. Accordingly, MoP vide its OM. dated 20.1.2017 has constituted the committee comprising of representatives from CEA, Punjab, Uttarakhand, Himachal Pradesh, TATA Power and other stakeholders. The MoP order also provides for invitation to representatives from small Hydro developer/ other utilities. Therefore, Himalayan Power Producers Association and Electrical Inspectorate division, CEA have been invited to the meeting and they are co-opted as committee members.

2. The representative of Himalaya Power Producers Association stated that Pole type tower structure is the preferred and common choice for 33 kV transmission lines, in which, the conductor is firmly fixed with Pin insulators. Even at the dead end, Disc Insulators firmly holds the conductor, therefore the swing of conductor is almost zero for 33 kV transmission lines. He stated that the RoW requirement of 15 m for 33 kV S/c transmission lines as per present MOEF guideline/ IS has been derived considering the swing of conductor in suspension insulator on lattice type tower structure, which is rare in hilly/ forest areas. He further stated that there are two types of configurations common on pole type structure i.e. Delta Configuration and Horizontal configuration and maximum RoW is required for horizontal configuration. As per IS 5613, conductor to conductor clearance required is 1.5 m and minimum phase to ground clearance of 0.33 m on both sides. Therefore, the RoW requirement for 33kV line (on pole structure) works out to be 6.66m, taking into consideration horizontal clearance of 1.83m as against RoW of 15m specified for 33kV. He further stated that for small hydro power developers, RoW compensation cost is substantial and effects the viability of the project.

3. The representative of Punjab stated that instead of Lattice type tower structure, Pole type towers are preferable for 33 kV in urban and forest areas. He further stated that where additional strength is required on account of wind pressure/additional height requirements, rail pole or cemented pole could be used. The RoW corridor of 15 m with Lattice type tower structure for 33kV is not in common use. He further stated that instead of freezing the RoW width, the same may be left open to the implementing agency as the RoW would vary depending on the type of structure used.

4. Director (EI) stated that the safety Regulations are under revision wherein the use of covered conductor/underground cable in wildlife/bird sanctuary, forest areas for 33 kV and below voltage level is being made mandatory to avoid accidental death of animals due to electrocution. Covered conductor would also reduce the RoW width substantially.

5. The representative of Uttarakhand stated that covered conductors are similar to Aerial Bunch Cables (ABC). With ABC, they are facing problems like insulation failure, leakage current etc. These issues needs to be considered while making the use of covered conductors mandatory upto 33 kV level in forest areas. He further stated that in hilly terrain, where poles are located on hill top, no cutting of trees is involved, still the forest authorities are claiming RoW compensation. In such cases, there should be no RoW compensation.

6. The representative of Tata Power stated that the horizontal clearance of 2m as per present regulation is very much on the higher side. At 11kV, horizontal clearance of 1.2 m is used and this 1.2 m also includes the phase to ground clearance of 0.33m. The horizontal clearance is basically safe distance to avoid accidental human contact with live wires. Therefore, the horizontal clearance of 1.2 m is also adequate for 33kV. To this additional clearance of 0.33 m may be added for the worst case, in that case also horizontal clearance for 33kV works out be 1.53m as against 2m.

7. It was seen that horizontal clearance mentioned in IS 5613 for 33 kV level is 1.83m whereas in the CEA Safety Regulations it is mentioned as 2m. Director (EI), CEA clarified that the clearance values in IS 5613 as well as CEA Safety Regulation has been taken from Indian Electricity Rules, 1956. The Electricity Rules, 1956 specifies horizontal clearance of 2m for 33kV level. He further stated that clearances are basically for human safety and to avoid accidental contact of human being with live conductor.

8. Representative of TATA Power was requested to carry out the calculations for electric fields at various distances as we move away from the live conductor for 33kV level. Tata Power agreed to carry out the studies.

9. Chief Engineer (PSETD) stated that ROW requirement works out to about 15m for span length of about 250m (with ACSR Dog conductor), which is normally considered for 33kV line with lattice structure. He further highlighted that although the developer is free to optimize the width of RoW by optimizing the width of tower base etc, a uniform fixed RoW should be defined for compensation purpose. He stated that in the manner the RoW matrix is being developed for voltage level of 66 kV and above, the same may be replicated for 33 kV voltage level. He apprised the participants that for 66 kV and above voltage level, the matrix that is being developed is defining the RoW for three different routes i.e. Urban/Populated area; Forest Area and Unrestricted area with different spans, tower configurations and conductor.

10. After detailed deliberations in the meeting, it was decided that CEA will forward the matrix listing down the combination of type of conductors, tower configuration, design span and type of insulator and members will have to furnish the RoW calculations for different configuration within a week. The matrix prototype is attached as **Annexure II**. The matter would be further deliberated in the next meeting after receipt of RoW calculation matrix and other relevant information from members of various utilities.

Annexure-I

List of participants of the meeting held on 02.02.2017 to deliberate and finalize Right of Way (RoW) requirements for transmission lines at 33 kV level

Sl. No.	Name Shri/Smt	Designation
I.	**CEA**	
1.	Ravinder Gupta	- Chief Engineer (PSP&PA)
2.	S. K. Ray Mohapatra	- Chief Engineer (PSETD)
3.	Ghanshyam Prasad	- Chief Engineer (DP&D)
4.	Awdhesh Kumar Yadav	- Director (PSP&PA-I)
5.	Upender Kumar	- Director (CEI)
6.	Manjari Chaturvedi	- Dy. Director (PSP&PA)
7.	Kavita Jha	- Dy. Director (PSETD)
8.	Priyam Srivastava	- Assistant Director
9.	Vikas Sachan	- Assistant Director
10.	Nitin Deswal	- Assistant Director
11.	Mohit Mudgal	- Assistant Director
II.	**Tata Power Delhi**	
12.	H.C. Sharma	- Head (Project)
III.	**PSPCL**	
13.	Sanjeev Gupta	- Dy CETL(Dsg.)
IV.	**HPSEBL**	
14.	R.K. Sharma	- Director
V.	**Uttarakhand Power Corporation Limited (UPCL)**	
15.	Er. P.C. Pandey	- Chief Engineer
VII.	**Himalaya Power Producers Association**	
16.	Pawan Kohli	-President
17.	Er. C.J. Rai	- Chief Engineer

Annexure - II

Table

Conductor type	Configuration	structure type (Lattice type/ Concrete Pole/Monopole/Rail pole/Double pole/ Single steel pole)	Design Span (in m)	String Type	Horizontal clearance (in m)	Insulator Length (Considered for Swing) (in m)	Max Sag at 85 Deg.C (in m)	Horizontal displacement from Conductor attachment point due to swing (in m)		Maximum Horizontal distance of Conductor attachment point from centre of tower /Pole (in m)	Width of right of way (in m)
B			C		D	E	F	H=(E+F)*Sin35	I=(E+F)*Sin60	X	R=2(D+H)+2X
ACSR DOG		Lattice type/ Steel Monopole	250	"I" String/Suspension	2.0						
				Tension	2.0	0					
			150	"I" String/Suspension	2.0						
				Tension	2.0	0					
		(Concrete Pole/Rail pole/H pole/ Single steel pole)	100	Pin Insulator	2.0	0					
			60	Pin Insulator	2.0	0					
ACSR Wolf		Lattice type/ Steel Monopole	250	"I" String/Suspension	2.0						
				Tension	2.0	0					
			150	"I" String/Suspension	2.0						
				Tension	2.0	0					
		(Concrete Pole/Rail pole/H pole/ Single steel pole)	100	Pin Insulator	2.0	0					
			60	Pin Insulator	2.0	0					

X= Internal deflection+ Live metal clearance + Tower barrel width (at bottom cross arm level)

NOTE: **Inputs desired from the members:**

1). Length of insulators (considered for swing)

2) Schematic showing the dimensions along with height of conductor attachment point indicating the ground clearance may be furnished.

3) Tower barrel width dimensions

Annexure-III

Minutes of the 2nd meeting of the committee to deliberate and finalize RoW requirements for transmission lines at 33kV held on 24.03.2017 at CEA

List of Participants is at **Annexure-I**

11. Chief Engineer (PSPA-I) welcomed the participants and stated that as decided in the first meeting of the Committee, CEA circulated the matrix for various combination of conductors, type of structure / pole configuration, design span to the members of the Committee, requesting for submission of Right of Way (RoW) calculations. He stated that the RoW calculations received from the members including the calculation of PSE&TD Division of CEA for RoW requirement for 33 kV voltage level is enclosed at **Annexure II**. He stated that the RoW calculation has been done assuming swing of conductor as 35 degrees & 60 degree, sag corresponding to maximum conductor operating temperature of 85° C and minimum horizontal clearance of 2 m on both sides as mandated in IS 5613. The variation in the RoW calculation furnished by the members is primarily because of the value of sag considered in calculations. The calculations of Himachal Pradesh and CEA are closely matching. He suggested that as the probability of occurrence of high wind at the maximum operating temperature of conductor (85° C) is very low , in order to optimize the RoW requirement we should consider the swing of conductor as 35 degree only. All the members present agreed to the suggestion.

12. The representative of Himalaya Power Producers Association stated that for uninhabited areas in hilly terrain, deriving the RoW width for 33 kV transmission lines with bare conductor, considering the horizontal clearance of 2 m as mandated by IS 5613 is very much on higher side. He requested to use the horizontal clearance of 0.33 m on either sides in calculation of RoW width for transmission lines passing through such uninhabitable areas such as hill slopes and valley.

13. Director, DPD, CEA said that as per IS 5613, the ROW takes into account the safety clearances as well as movement of vehicle for transportation of material during construction and maintenance of the lines. It may be kept in mind while reducing the ROW with reference to the values given in IS 5613.

14. Chief Engineer (CEI), CEA stated that CEA (Measures relating to Safety and Electric Supply) Regulations, 2010 are under revision, wherein it has been proposed that in case of transmission lines of 33 kV and below voltage level passing through National Parks, Wildlife Sanctuaries and Wildlife Corridors, underground cables or overhead insulated (covered) conductors shall only be used to prevent accidental death of animals due to electrocution. The use of covered conductors for 33 kV and below voltage level is also being considered in habitable areas. He stated that in the absence of electric field calculations at various distances from the center line of the tower / pole, it is difficult to reduce the horizontal clearance of 2m, which has been considered for more than six decades, for 33 kV transmission lines as mentioned in CEA Safety Regulations, 2010. However, there is scope for reduction in the horizontal clearance with covered conductors, which would be finalized as and when safety Regulation gets revised.

15. The representative of Himalaya Power Producers Association stated that mandating the use of covered conductors for 33 kV and below transmission lines

passing through wildlife/bird sanctuary is indeed required. However, mandating the same for transmission lines passing through hilly terrain and valleys (where minimum tree cutting is required) is not necessary. He requested that choice of conductor (bare or covered) should be left to the utility / developer. He added that a line may be passing through forest, non-habitable and habitable area, therefore, RoW should be defined separately for habitable, forest areas and non-habitable areas.

16. Chief Engineer (CEI), CEA stated that this exercise of optimizing the RoW is for the purpose of compensation only and we cannot specify different RoW for different section of the line. Therefore, RoW requirement should be uniform for the entire route of the transmission line. CE (PSETD), CEA said that different RoW for different section of the line might pose problem in deciding the compensation amount. He also advocated for indicating RoW width for compensation purpose.

17. Director, CEA stated that in the 1st meeting of the Committee, TATA Power was requested to carry out the calculations for electric fields at various distances within the RoW. The field calculation is yet to be submitted by TATA power. Himachal Pradesh has submitted the electric field calculations along with the RoW calculations. Director (EI), CEA stated that if the calculations for the electric field strength at varying distances from the centre line of tower / pole upto the edge of RoW is furnished by Tata Power and other power utilities, then the possibility of reduction in horizontal clearance, which has been considered as 2 m in arriving at the RoW requirement for 33 kV voltage level, would be explored / deliberated further.

18. On a query from CE(EI), CEA regarding the prevalent practice (for clearing the RoW) for laying of 33 kV transmission lines in forest area, representative of Himalaya Power Producers Association and Uttarakhand stated that for laying of the line, the vegetation / trees within RoW are pruned to maintain minimum electrical safety clearance, however, the compensation is paid for the full RoW width of 15 m for 33 kV.

19. Chief Engineer, PSETD stated that the matrix being proposed by CEA for RoW width takes into account different types of structure, commonly used ACSR conductor at 33kV level, normal design span, swing of conductor as 35 degree, minimum horizontal safety clearance of 2m. The RoW requirement can be further reduced to 6m by using covered conductor.

20. After detailed deliberations, the committee recommended the following:

    (i) The ROW width for (a) 33kV overhead transmission lines for different types of structures, commonly used ACSR conductor (with maximum operating temperature of 85 degree) & normal design span and (b) for 33kV lines with covered conductor mounted on pole type structure shall be as indicated below.

33 kV RoW requirement for various configuration

Conductor	Structure Type	Design Span (in m)	String Type	**RoW recommended (in m)**
Commonly used ACSR Bare conductor	Lattice type/ Steel Monopole	250	"I" String/Suspension	15 meter
			Tension	
		150	"I" String/Suspension	12 meter
			Tension	
	(Concrete Pole/Rail pole/H pole/ Single steel pole)	100	Pin Insulator	9 meter
		60	Pin Insulator	8 meter
Covered	Pole	100		6 meter

(ii) The CEA Safety Regulations, 2010 are under revision, wherein it has been proposed that in case of transmission lines of 33 kV and below voltage level passing through National Parks, Wildlife Sanctuaries and Wildlife Corridors, underground cables or overhead insulated (covered) conductors shall only be used to prevent accidental death of animals due to electrocution. The RoW width of 6m recommended for 33kV transmission lines with covered conductors mounted on Pole type structure would be further looked into, if required, as and when amendments in Safety regulations, 2010 will come into effect.

(iii) These recommendations would form part of the main report of the Committee finalizing compensation in regard to Right of Way for transmission line falling in urban areas.

(iv) The possibility of reduction in minimum safe horizontal clearance of 2m, and reduction in the RoW width for 33kV lines with covered conductors mounted on Pole type structure would be deliberated further while bringing out the revision of (Measures relating to Safety and Electric Supply) Regulations.

Meeting ended with thanks to the chair.

Annexure-I

List of participants in the 2nd meeting of the committee to deliberate and finalize RoW requirements for transmission lines at 33kV held on 24.03.2017 at CEA

Sl. No.	Name Shri/Smt	Designation
I.	**CEA**	
1.	Ravinder Gupta	- Chief Engineer (PSP&A-I)
2.	Goutam Roy	- Chief Engineer (CEI)
3.	S.K. Ray Mohapatra	- Chief Engineer (PSETD)
4.	Ghanshyam Prasad	- Chief Engineer (DP&D)
5.	Awdhesh Kumar Yadav	- Director
6.	Vivek Goel	- Director
7.	Upendra Kumar	- Director
8.	Manjari Chaturvedi	- Dy. Director
9.	Shiva Suman	- Dy. Director
10.	C.N. Devarajan	- Dy. Director
11.	Priyam Srivatava	- Assistant Director
12.	Jitesh Srivas	- Assistant Director
13.	Vijay Pal	- Sr. Consultant
II.	**HPPA , SHIMLA**	
14.	Powan Koli	-Vice President
15.	C.J. Rai	-Secy. General
III.	**HPSEB Ltd. , Hamirpur**	
16.	Lukesh Kumar	- Sr. Executive Engineer
17.	Pritam Chand	- SE (Design)
IV.	**TPDDL**	
18.	Kapil Kumar	- AGM (PE)
V.	**Uttarakhand Power Corp.**	
19.	P.C. Pandey	- Chief Engineer

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Annexure II

																	UK	HPPA	HP			
Conductor type	Configuration	structure type (Lattice type/ Concrete Pole/Monopole/ Rail pole/Double pole/ Single steel pole)	Design Span (in m)	String Type	Horizontal clearance (in m)	Insulator Length (Considered for Swing) (in m)	Max Sag at 85 Deg.C (in m)	Horizontal displacement from Conductor attachment point due to swing (in m)		Maximum Horizontal distance of Conductor attachment point from centre of tower (Pole	Width of right of way (in m)			Width of right of way (in m) (with 35° swing)	Width of right of way (in m) (with 60° Swing)	Approx. Width of right of way (in m)	Approx. Width of right of way (in m)	Approx. Width of right of way (in m)	Electric field with horizontal configuration (in kV/m)		Electric field with Delta Configuration (in kV/m)
B			C		D	E	F	H=(E+F)*Sin35	I=(E+F)*Sin60	X	R=2(D+I)	R=2(D+H)	+2X	R=2(D+H)+2X	R=2(D+I)+2X				At edge of ROW	At 0.5 m from conductor	
											(with 60° swing)	(with 35° swing									
ACSR DOG		Lattice type/ Steel Monopole	250	I" String/Suspensio	2.0	0.75	5.61	3.65	5.50	2.20	15.01	11.29	+2X	15.69	19.41	11.03		14.10/12.57¶	0.15	5.34	0.99
				Tension	2.0	0	5.61	3.21	4.85	2.20	13.71	10.43	+2X	14.83	18.11	10.46		13.39/11.87¶	0.16	5.34	1.01
			150	I" String/Suspensio	2.0	0.75	2.63	1.94	2.93	2.20	9.86	7.88	+2X	12.28	14.26	10.34		10.25/8.73**	0.32	5.34	1.30
				Tension	2.0	0	2.63	1.51	2.28	2.20	8.56	7.02	+2X	11.42	12.96	9.86		10.02/8.5**	0.31	5.34	1.29
	Horizontal	(Concrete Pole/Rail pole/H pole/ Single steel pole)	100	Pin Insulator	2.0	0	1.50	0.86	1.30	1.55	6.60	5.72	+2X	8.82	9.70	6.965/8.49	5.36	8.75	0.44	5.34	
			60	Pin Insulator	2.0	0	0.77	0.44	0.66	1.55	5.33	4.88	+2X	7.98	8.43	6.905/8.43	4.52	7.92	0.56	5.34	
	Delta	(Concrete Pole/Rail pole/H pole/ Single steel	100	Pin Insulator	2.0	0	1.50	0.86	1.30	0.78	6.60	5.72	+2X	7.28	8.16	6.965/8.49	5.36	7.22			1.44
			60	Pin Insulator	2.0	0	0.77	0.44	0.66	0.78	5.33	4.88	+2X	6.44	6.89	6.905/8.43	4.52	6.39			1.56
ACSR Wolf		Lattice type/ Steel Monopole	250	I" String/Suspensio	2.0	0.75	4.96	3.27	4.94	2.20	13.89	10.55	+2X	14.95	18.29	10.93		13.33/11.81¶	0.18	5.59	1.19
				Tension	2.0	0	4.96	2.84	4.30	2.20	12.59	9.69	+2X	14.09	16.99	10.40		12.64/11.11¶	0.19	5.59	1.22
											0.00	0.00	+2X								
			150	I" String/Suspensio	2.0	0.75	2.253	1.72	2.60	2.20	9.20	7.44	+2X	11.84	13.60	10.26		9.87/8.35**	0.36	5.59	1.53
				Tension	2.0	0	2.25	1.29	1.95	2.20	7.90	6.58	+2X	10.98	12.30	9.78		9.58/8.06**	0.36	5.59	1.53
	Horizontal	(Concrete Pole/Rail pole/H pole/ Single steel pole)	100	Pin Insulator	2.0	0	1.23	0.71	1.07	1.55	6.13	5.41	+2X	8.51	9.23	6.905/8.43	4.94	8.33	0.51	5.59	
			60	Pin Insulator	2.0	0	0.58	0.33	0.50	1.55	5.00	4.66	+2X	7.76	8.10	6.77	4.3	7.69	0.63	5.59	
	Delta	(Concrete Pole/Rail pole/H pole/ Single steel pole)	100	Pin Insulator	2.0	0	1.23	0.71	1.07	0.78	6.13	5.41	+2X	6.97	7.69	6.905/8.43	4.94	6.81			1.71
			60	Pin Insulator	2.0	0	0.58	0.33	0.50	0.78	5.00	4.66	+2X	6.22	6.56	6.77	4.3	6.17			1.82

** higher value is calculated using value of X=1.525 &
lower value is calculated using value of X=0.763

Appendix IX

Minutes of the 6th meeting of the Committee Chaired by Ms. Shalini Prasad, Additional Secretary, Ministry of Power (MoP) on 09-05-2017 for finalization of compensation in regard to Right of Way (RoW) for Transmission line falling in urban areas

List of Participants is at **Annex – I**.

1. Additional Secretary, MoP welcomed the participants. She stated that the recommendations made in the Draft Report for finalization of compensation in regard to Right of Way (RoW) for Transmission line falling in urban areas were already circulated with the meeting notice and is to be discussed with the Members of the Committee.

2. Representative of MoUD stated that their guidelines already includes the provision of sub-stations and space to be left for transmission lines. On going through the guidelines, the Committee members observed that the provisions made in the guidelines are basically the mandatory safety clearances required for transmission lines at various voltage levels which has to be followed by all utilities. However, the requirement/recommendation of the Committee is that while town planning separate corridors for laying of transmission lines should be clearly identified in consultation with the State Transmission Utilities.The same has been recommended at item No. 5.7 (viii) of the Report.

3. The recommendations of the Committee was discussed item-wise and Members of the Committee were in agreement on the Draft Report except for minor changes.

4. Additional Secretary, MoP requested the Committee members to send their additional comments, if any, within a week so that the final report could be released.

5. The meeting concluded with thanks to chair