



**भारत सरकार/Government of India**  
**विद्युत मंत्रालय/Ministry of Power**  
**केन्द्रीय विद्युत प्राधिकरण/Central Electricity Authority**  
**विद्युत प्रणाली अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग**  
**Power System Engineering & Technology Development Division**

दिनांक: 24.09.2024

To,

<As per attached list>

**विषय: Report of the Committee for calculation of reduction of Right-Of-Way (ROW) width through technological options**

A committee was constituted as per CEA's File No.CEA-PS-14-86/2/2019-PSETD Division dated 25.07.2023 for calculation of reduction of Right-Of-Way (ROW) width through technological options.

2. The Term of reference of the committee are as under:
  - a. Calculation of Right of Way (ROW) Width in case of Insulated Cross Arm Insulators
  - b. Calculation of Right of Way (ROW) Width in case of Monopole Towers.
  - c. Calculation of Right of Way (ROW) Width in case of HTLS Conductors.
3. Five (5) Numbers of meetings of the committee were held on 23.08.2023, 31.10.2023, 01.03.2024, 15.05.2024 and 13.09.2024.
4. Ministry of Power (MoP) vide letter no. 3/4/2016-Trans dated 11th August 2016 had constituted a committee under the Chairmanship of Additional Secretary, Ministry of Power to analyze the issue relating to Right-of-way (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. The report of the Committee was circulated to all stakeholders vide letter No.3/4/2016-Trans, dated 16th July 2020 (copy attached). The report, inter-alia, provided ROW for normal route, forest area, urban area, populated area and approach section near substation.

5. In addition to the options available in the report of MoP, other technological options i.e. Monopole tower and HTLS conductors has been considered. Accordingly, Right of Width (RoW) for ACSR conductor with Pole structure, HTLS conductor with Pole structure and RoW for HTLS conductor with conventional type towers (Lattice) has been calculated and the report of the committee is attached.

भवदीय,

21/09/2024

(भंवर सिंह मीना /Bhanwar Singh Meena)

निदेशक/Director

**Copy to:**

1. Joint Secretary (Trans.), Ministry of Power
2. Chief Engineer (CEI) ,CEA
3. Chief Engineer (PSPA-I) ,CEA
4. Chief Engineer (PSPA-II) ,CEA
5. Chief Engineer (PCD), CEA
6. SA to Chairperson, CEA
7. SA to Member (PS), CEA



# प्रौद्योगिकी विकल्पों के माध्यम से राइट-ऑफ-वे की चौड़ाई में कमी की गणना के लिए समिति की रिपोर्ट

## Report of the Committee for calculation of reduction of Right-of-Way (RoW) width through technological options



भारत सरकार  
केन्द्रीय विद्युत प्राधिकरण  
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नई दिल्ली  
Government of India  
Central Electricity Authority  
Ministry of Power  
New Delhi

September, 2024



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Right-of-Way (RoW) width through technological options**

**By**

**Power System Engineering & Technology Development  
Central Electricity Authority**

**भारत सरकार  
केन्द्रीय विद्युत प्राधिकरण  
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**September, 2024**

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## **Report of the Committee for calculation of reduction of Right-of-Way (RoW) width through technological options**

### **1. Background**

- i. Ministry of Power (MoP) vide letter no. 3/4/2016-Trans dated 11<sup>th</sup> August 2016 had constituted a committee under the Chairmanship of Additional Secretary, Ministry of Power to analyse the issue relating to Right-of-way (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. The report of the Committee was circulated to all stakeholders vide letter No.3/4/2016-Trans, dated 16<sup>th</sup> July 2020. The report, interalia, provided ROW for normal route, forest area, urban area, populated area and approach section near substation.
- ii. Based on the recommendations of the above mentioned report, Right-of-Way (RoW) width for transmission lines of different voltage levels (with specific conductor type and configuration, design span and insulator string arrangement) traversing through normal terrain or route without constraints, forest area, urban area, populated area and approach section near substation were finalised. These data were included in SCHEDULE-VII of the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022 [refer regulation 84(4)]. There are number of technical options such as Monopole tower, insulated cross-arm, High Temperature Low Sag (HTLS) conductor that can be explored by utilities to further optimize RoW Width. Therefore, in addition to the RoW width for the options available in the Schedule-VII of the Central Electricity Authority (Technical Standards for construction of Electrical Plants and Electric Lines) Regulations, 2022, there is a requirement of specifying RoW width for such technological options. Accordingly, RoW width has been calculated for Lattice tower/Monopole Tower with ACSR/HTLS Conductor (ACSS/CFCC/GAP) based on certain assumptions which are given in Para No. 4 (d). Optimization of RoW using such options will enable utilities to reduce requirement in congested areas and optimize requirement of tree cutting in forest area.
- iii. For the calculation of RoW width, values of various parameters, such as horizontal distance of conductor's attachment point from centre of lattice tower, swing angle, suspension insulator length, etc have been taken the same as were adopted for the calculation of ROW in the above mentioned report dated 16<sup>th</sup> July 2020.

## 2. Constitution of Committee

- i. Requirement was felt for reduction of Right-of-way (RoW) in view of various technological options available. To address the issue, a committee was constituted as per CEA's **File No.CEA-PS-14-86/2/2019-PSETD Division dated 25.07.2023**, with the following composition and terms of reference:

1.	Chief Engineer (PSE&TD), CEA	Chairperson
2.	Representative of M/s Powergrid	Member
3.	Representative of M/s KPTCL	Member
4.	Representative of M/s Mahatransco	Member
5.	Representative of M/s GETCO	Member
6.	Representative of M/s PTCUL	Member
7.	Representative of M/s DTL	Member
8.	Representative of EPTA	Member
9.	Representative of M/s CTC Global	Member
10.	Representative of M/s Tokyo Rope International (a subsidiary of Tokyo Rope Mfg. Co., Ltd.)	Member
11.	Chief Engineer (CEI), CEA	Member
12.	Chief Engineer (PCD), CEA	Member
13.	Director (PSE&TD), CEA	Member & Convener

Terms of Reference:

1. *Calculation of Right of Way (ROW) Width in case of Insulated Cross Arm Insulators*
2. *Calculation of Right of Way (ROW) Width in case of Monopole Towers.*
3. *Calculation of Right of Way (ROW) Width in case of HTLS Conductors.*

## 3. Brief Proceedings of Committee

- i. First Meeting of the committee was held on 23.08.2023 and following deliberations took place:
- KPTCL suggested that in place of specifying the RoW for every combination an empirical formula may be provided and based on the technical parameters of the line, the utilities may calculate the RoW as per the formula. KPTCL further suggested following formula for calculation of the RoW:

$$\text{Right of Way (RoW)} = 2x \{ (\text{Cross arm spread from Tower Centre}) + [(\text{suspension string length} + \text{Maximum Conductor Sag}) \times \text{Sin}(\varphi)] + (\text{Minimum Horizontal Clearance as per CEA Regulations}) \}$$

Where  $\varphi$  - Maximum Deflection Angle based on Wind Zone

- However, representatives from POWERGRID, PTCUL, GETCO and M/s Shemar pointed out that different utilities are having different tower designs and are falling under different wind zones and hence the RoW calculated on basis of the empirical formula may vary from utility to utility. The implementation of transmission projects with non-uniform RoW width will be difficult to manage at the site and a uniform RoW may be suggested by the committee for all the possible configurations.
  - Chief Engineer (PSETD), CEA highlighted that depending upon the various possible type of towers, configuration of towers, conductor types, insulator string type, type of cross arms, design span, terrain, etc the total number of RoW combinations will be quite large and it will be a cumbersome task to tabulate all possible types of combinations. Therefore, he requested all the stakeholders to assist in finalization of the RoW values with possible number of combinations.
  - Minutes of the meeting are attached as **Appendix-I**.
  - After the first meeting M/s Sterlite submitted the Row calculations for fixed swing angle and different swing angles.
- ii. Second Meeting of the committee was held on 31.10.2023. Based on the deliberations held in the meeting following points were concluded:
- There will be a separate RoW calculations for lattice type structures and a separate RoW width with other technical solutions i.e. Monopole, Inverted cross arm, twin monopole structures etc will be kept separately.
  - Swings of suspension insulator and conductor may be fixed as 35 degrees irrespective of the voltage level/Span/Wind Zone to have uniformity in calculation of RoW.
  - RoW width calculations for “V string and Insulated Cross Arm type insulators may be clubbed together whereas RoW width calculations for “I” string insulators may be done separately. RoW widths with tension insulator strings may not be calculated separately.
  - The RoW width calculated shall be valid for altitude upto 1000 m above mean sea level (MSL).
  - For easier adoption by the stakeholders, after finalization of RoW widths, the same will be incorporated in Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, and the same will be communicated to stakeholders and published on CEA website.



- The RoW width calculations, the CEA regulations and relevant codes are to be complied with.
  - Regarding HTLS conductors, committee members will provide inputs whether separate RoW in respect of individual conductor type is to be adopted for various voltage levels or RoW with two or three conventional type conductors for specific voltage level is to be adopted.
  - Committee members, in association with the Pole manufacturers, will come up with RoW width calculations after combining “V and ICA” string type insulators, transmission lines with single side stringing, narrow base towers, mono pole, twin pole structures, etc. The inputs received will be circulated to other members of committee for examination before the next meeting.
  - Minutes of the meeting are attached as **Appendix-II**.
  - After the second meeting M/s Sterlite submitted the Row calculations for fixed swing angle.
- iii. Third Meeting of the committee was held on 01.03.2024 and following deliberations took place:
- Earth wire to live metal clearance must be maintained at different conductor temperature.
  - RoW calculations could involve factors like voltage levels, tower types, conductor types, and string types (such as I string and ICA/V string), along with terrain category. Considering the extensive data involved, making certain assumptions might be necessary to simplify and organize the information more effectively.
  - M/s Sterlite to submit RoW calculations for Lattice type structure for various types of HLTS conductors at their highest operating temperature so that it can be compared if there is any saving in RoW.
  - M/s Powergrid to carryout RoW calculations for Monopole, Inverted cross arm and Twin Pole structure, etc for ACSR conductor.
  - Minutes of the meeting are attached as **Appendix-III**.
  - After the meeting, M/s Sterlite submitted calculations for various HTLS conductors and M/s Powergrid submitted calculations for pole structures.
- iv. Forth Meeting of the committee was held on 15.05.2024. Based on the deliberations held in the meeting following points were concluded:
- M/s Powergrid to provide the ROW width calculations using tension string for pole structures. The electric field at lowest point of conductor and at edge of RoW (kV/m) indicating the limits of electric field to be provided for all combinations of RoW.
  - M/s Sterlite to provide calculations of ROW width at the highest operating temperature for all types of HTLS conductors and the parameter i.e. the electric field at lowest point of conductor and at edge of ROW (kV/m) indicating the limits of electric field. The combinations like terrain category, circuit type, voltage level, design span, conductor type (indicating maximum operating temperature for different types of HTLS conductors), etc. shall also

be included in RoW width calculations. M/s Sterlite to provide calculations of mid span clearance between earth wire/Optical Ground Wire (OPGW) and HTLS conductors in case of up-gradation of existing transmission lines as well as for new transmission lines.

- KPTCL to submit the calculations of RoW width for D/C single side cross arm for monopole structures at 110 kV and 220 kV voltage levels.
  - All the committee members to review the calculations to be submitted by M/s Powergrid and M/s Sterlite and to provide the justification in case they do not agree with the calculations within 15 days.
  - The Committee members were requested to provide their views on KPTCL's proposal of designing 110 kV D/C narrow base tower with increased bottom cross arm height for laying of transmission lines through forest areas to avoid excessive tree cutting.
  - Minutes of the meeting are attached as **Appendix-IV**.
- v. Fifth Meeting of the committee was held on 13.09.2024. Based on the deliberations held in the meeting following points were concluded:
- Single circuit transmission lines shall not be used up to 400 kV voltage level. Therefore, Committee decided that RoW width shall not be specify for the Single Circuit tower up to 400 kV voltage level.
  - M/s Sterlite to provide input “PLSCAD” files for sag calculations to the POWERGRID.
  - POWERGRID to review the sag calculation submitted by M/s Sterlite and provide data regarding phase to phase spacing for 132 kV line.
  - POWERGRID and M/s Sterlite to provide input in respect of electric and magnetic fields.
  - KPTCL to provide the relevant data to calculate the RoW width for pole structures used in Karnataka.
  - M/s Sterlite to provide sag calculation for ACSR Bersimis equivalent HTLS conductor for 765 kV line.
  - The utility representatives present at the meeting were requested to provide their inputs and comments on the Right of Way (RoW) table, ensuring that the required phase-to-phase spacing, safety electrical clearances, and limits for electric and magnetic fields comply with the relevant standards and CEA regulations.
  - Minutes of the meeting are attached as **Appendix-V**.

#### 4. Methodology

- (a) Generally, the transmission line towers are of two types (a) self-supporting type (lattice structure / steel pole structure) (b) Guyed type. In India, most commonly self-supporting lattice structures are being used for EHV transmission lines. In recent years, use of monopole structures are also increasing in specific areas due to much reduced footprints, less number of components and faster erection & commissioning. The high cost, difficulty in transportation, increase in number of poles due to reduction in design span, special design consideration for multi-circuit towers and limited manufacturing facilities are some of the bottlenecks in construction of transmission lines with monopole structure.
- (b) Right of Way (RoW) is the strip of land immediately below and adjacent to a transmission line. The RoW also provide an access corridor for maintenance of transmission lines. The width of RoW required for a transmission line is based on the consideration for safety clearances as per CEA (Measures relating to safety and Electric supply) Regulations 2023. During the process of defining RoW width, the general safety requirements including minimum live metal clearance, ground clearance, surface gradient, corona loss, Radio Interference Voltage (RIV), **Audible Noise and minimum mid-span separation between earth wire and conductor, Electromagnetic Field (EMF i.e. induced voltages etc) exposure limits and design consideration for tower structure, shall be kept as per regulations and relevant standards.**

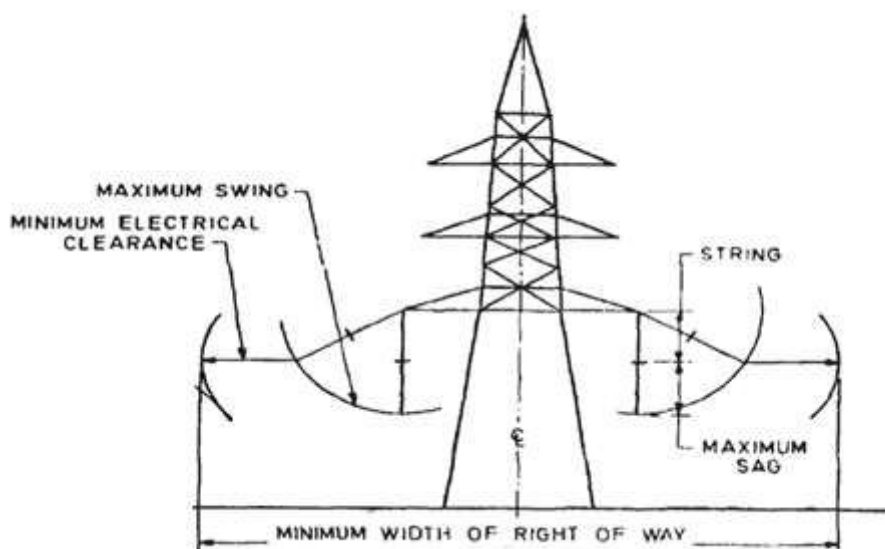


Figure-1

- (c) RoW requirement for transmission line depends on following factors:
- i. Configuration of Tower [S/C (Horizontal / Delta / Vertical) or D/C (Vertical)]
  - ii. Span length
  - iii. Sag of Conductor, which depends on type of conductor used, maximum operating temperature of the conductor, and Span length
  - iv. Wind velocity and angle of swing
  - v. Projection of Cross arm or distance of conductor attachment point from centre line of tower, which depends on wind velocity, swing angle, metal clearance, cage width or tower body width at bottom conductor level
  - vi. Minimum horizontal and Vertical safety clearances as per CEA (Measures relating to safety and Electric supply) Regulations, 2023.
  - vii. Electric field limits below bottom most conductor and at edge of RoW
  - viii. Configuration of insulators [I / V configuration] and length of insulator string
- (d) In addition to the options available in the report of MoP, other technological options i.e. Monopole tower, HTLS conductors and combinations thereof have been identified for which RoW width has been calculated based on certain assumptions given as under:
- (i). RoW for pole structure is calculated for conventional Aluminum Conductor Steel Reinforced (ACSR), Carbon Fiber Composite Core (CFCC), Aluminium Conductor Steel Supported (ACSS), Gap-type Aluminium Conductor Steel Reinforced (GAP) conductors at different voltage levels.
  - (ii). RoW has been indicated for different insulator string configurations (I, V, tension type Insulator string configuration).
  - (iii). Swing angle has been fixed at 35 degree.
  - (iv). The minimum electrical clearance mentioned in **Figure-1** is as per the Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023
  - (v). For pole structures, the horizontal phase to phase distance i.e. twice the horizontal distance of conductor attachment point from center of Pole (X) has been taken as per data submitted by POWERGRID.
  - (vi). For lattice structures, the horizontal phase to phase distance i.e. twice the horizontal distance of conductor attachment point from center of tower (X) has been taken from MoP's *report dated 16<sup>th</sup> July 2020*.
  - (vii). The RoW has been defined for Aluminium Conductor Steel Supported (ACSS) conductor at 250 degree Celsius, Carbon Fiber Composite Core (CFCC) conductor at 180 degree Celsius and GZTACSR (Gap-type Aluminium Conductor Steel Reinforced (GAP conductor) conductor at 210 degree Celsius). Sag data for these conductors was provided by M/s Sterlite which was verified by POWERGRID.

- (viii). Sag in meter (m) of Aluminum Conductor Steel Reinforced (ACSR) conductors at different design span for defining RoW widths for Pole structures has been taken as per data submitted by POWERGRID.
- (e) The required phase to phase spacing and horizontal spacing between conductors for any voltage level is generally governed by the tower design as well as minimum live metal clearances corresponding to that voltage level under different swing angles of the insulator. Accordingly, the horizontal distance of the conductor attachment point from center of tower/pole (“X”) will vary as per tower/pole design and minimum live metal clearances. It is the responsibility of the concerned/implementing agency to meet the required clearances and safety parameters as per relevant standards and CEA’s regulations.
- (f) RoW for ACSR conductor with Pole structure, HTLS conductor with Pole structure and RoW for HTLS conductor with conventional type towers (Lattice) are tabulated in **Table 1**, **Table 2** and **Table 3** respectively. These ROW values are applicable for altitude upto 1000 m only. For lines passing through an altitude of more than 1000 m, necessary altitude correction factor as per relevant standards may be applied. The formula for calculation of RoW has been provided at **Annexure-I**.
- (g) The RoW provided in the table is indicative and has been calculated based on the specified design span, maximum sag of the conductor, horizontal distance of the conductor attachment point from centre of Pole/Tower as per prevalent practices and horizontal electrical clearance requirement as per CEA (Measures Relating to Safety and Electric Supply) Regulations 2023. All parameters used for calculations have been provided in **Annexure-II** . The RoW may vary with change in any of the above parameters. RoW for different parameters may be calculated as per **Annexure-I**.
- (h) Reduction of RoW using Insulated Cross Arm (ICA) was also discussed by the Committee as one of the technological options. However, since the use of insulated cross arm is not much in practice in Indian transmission system, the verified data could not be received for calculation of RoW. However, if any utility wants to use insulated cross arm, the formula given in **Annexure-I** may be utilized considering all safety aspects.

**Table 1****Right of Way for Normal Route, Forest Area, Urban Area / Populated Area / Approach Section near Substation for Pole Structures with ACSR conductor**

<b>Voltage Level</b>	<b>Configuration</b>	<b>Conductor type</b>	<b>Terrain</b>	<b>Design Span(m)</b>	<b>String Type</b>	<b>ROW width (m)</b>
765 kV S/C	Vertical DELTA	ACSR BERSIMIS	Normal route without constraints	250	Tension I String	52
			Forest area	250	Tension	
			Urban area/Populated area/approach section near substation		V String	46
400 kV D/C	Vertical	ACSR MOOSE	Normal route without constraint	250	Tension I String	36
			Forest area	250	Tension	
			Urban area/Populated area/approach section near substation		V String	31
220 kV D/C	Vertical	ACSR ZEBRA	Normal route without constraint	350	Tension I String	31
			Forest area	250	Tension I String V String	
			Urban area/Populated area/approach section near substation	200	Tension I String V String	24
132 kV D/C	Vertical	ACSR Panther	Normal route without constraint	325	Tension I String	25

			Forest area	200	Tension I String V String	<b>20</b>
			Urban area/Populated area/approach section near substation	150	Tension I String V String	<b>18</b>
110 kV D/C	Vertical	ACSR Lynx	Urban area/Populated area/approach section near substation	150	Tension I String V String	<b>16</b>

Note: All the electrical clearances and safety parameters shall be meet within the RoW as per relevant standards and CEA regulations.

**Table 2****Right Of Way for Normal Route, Forest Area, Urban Area / Populated Area / Approach Section near Substation for Pole Structures with HTLS conductor**

<b>Voltage Level</b>	<b>Configuration</b>	<b>Conductor type</b>	<b>Terrain</b>	<b>Design Span(m)</b>	<b>String Type</b>	<b>ROW width (m)</b>
400 kV D/C	Vertical	CFCC Dia:31.77 mm	Normal route without constraint	250	Tension	34
					I String	
			Forest area	250	Tension	29
Urban area/Populated area/approach section near substation	V String					
400kV D/C	Vertical	ACSS Dia:37.77 mm	Normal route without constraint	250	Tension	39
					I String	
			Forest area	250	Tension	33
Urban area/Populated area/approach section near substation	V String					
400kV D/C	Vertical	GAP Dia:29.9m m	Normal route without constraint	250	Tension	37
					I String	
			Forest area	250	Tension	31
Urban area/Populated area/approach section near substation	V String					
220kV D/C	Vertical	CFCC Dia:28.14 mm	Normal route without constraint	350	Tension	26
					I	



					String V String	
			Forest area	250	Tensi on I String V String	23
			Urban area/Populated area/approach section near substation	200	Tensi on I String V String	22
220kV D/C	Vertical	ACSS Dia:28.04 mm	Normal route without constraint	350	Tensi on I String	33
			Forest area	250	Tensi on I String V String	27
					Tensi on I String V String	
			Urban area/Populated area/approach section near substation	200	Tensi on I String V String	25
					Tensi on I String V String	
			220kV D/C	Vertical	GAP Dia:27.1m m	Normal route without constraint
Forest area	250	Tensi on I String V String				26
		Tensi on I String V String				
Urban area/Populated area/approach section near substation	200	Tensi on I String V String				24
		Tensi on I String V String				
132 kV	Vertical	CFCC				Normal route

D/C		Dia:21 mm	without constraint		on	<b>22</b>
					I String	
			Forest area	200	Tension	<b>18</b>
					I String	
			Urban area/Populated area/approach section near substation	150	V String	<b>17</b>
					Tension	
I String	V String	Tension	<b>26</b>			
				I String		
132 kV D/C	Vertical	ACSS Dia:20.5 mm	Normal route without constraint	320	V String	<b>21</b>
					Tension	
			Forest area	200	I String	<b>19</b>
					V String	
			Urban area/Populated area/approach section near substation	150	Tension	<b>25</b>
					I String	
I String	V String	Tension	<b>20</b>			
				I String		
Urban area/Populated area/approach section near substation	150	V String	<b>19</b>			
		Tension				

**Note:**

- a) *Carbon Fiber Composite Core (CFCC); Sag is calculated at 180 °C.*
- b) *Aluminium Conductor Steel Supported (ACSS): Sag is calculated at 250 °C.*
- c) *GZTACSR: Gap-type Aluminium Conductor Steel Reinforced (GAP conductor); Sag is calculated at 210 °C.*
- d) *Sag for the above conductors are as per design mentioned in CEA's Guidelines for Rationalised use of High Performance Conductors*
- e) *All the electrical clearances and safety parameters shall be meet within the RoW as per relevant standards and CEA regulations.*

**Table-3**  
**Right of Way for Normal Route, Forest Area, Urban Area / Populated Area / approach**  
**Section near Substation for Lattice Tower Structures and HTLS conductor**

Voltage level (kV)	Configuration	Conductor type	Terrain	String Type	Design Span (m)	ROW width (m)
400 kV D/C	Vertical	CFCC	Normal Route	I string	400	43
				V String		
				Tension		
		ACSS	Normal Route	I string	400	50
				V String		
				Tension		
		GAP	Normal Route	I string	400	48
				V String		
				Tension		
		CFCC	Forest	V String	300	38
				Tension		
		ACSS	Forest	V String	300	43
Tension						
GAP	Forest	V String	300	41		
		Tension				
CFCC	Urban/ Populated	V String	250	35		
		Tension				
ACSS	Urban/ Populated	V String	250	40		
		Tension				
GAP	Urban/ Populated	V String	250	38		
		Tension				
220 kV D/C	Vertical	CFCC	Normal Route	I string	350	27
				V String		
				Tension		
		ACSS	Normal Route	I string	350	33
V String						
Tension						

132 kV D/C	Vertical	GAP	Normal Route	I string	350	<b>31</b>
				V String		
				Tension		
		CFCC	Forest	V String	300	<b>24</b>
				Tension		
		ACSS	Forest	V String	300	<b>30</b>
				Tension		
		GAP	Forest	V String	300	<b>28</b>
	Tension					
	CFCC	Urban/ Populated	V String	250	<b>23</b>	
			Tension			
	ACSS	Urban/ Populated	V String	250	<b>27</b>	
			Tension			
	GAP	Urban/ Populated	V String	250	<b>26</b>	
Tension						
Vertical	CFCC	Normal Route	I string	320	22	
			V String			
			Tension			
	ACSS	Normal Route	I string	320	27	
			V String			
			Tension			
	GAP	Normal Route	I string	320	26	
			V String			
			Tension			
	CFCC	Forest	V String	200	19	
Tension						
ACSS	Forest	V String	200	22		
		Tension				
GAP	Forest	V String	200	21		
		Tension				
CFCC	Urban/ Populated	V String	150	18		
		Tension				

66 kV D/C		ACSS	Urban/ Populated	V String	150	20		
				Tension				
		GAP	Urban/ Populated		V String	150	19	
					Tension			
	Vertical	CFCC	Normal Route		I string	250	<b>16</b>	
					V String			
			ACSS	Normal Route		I string	250	<b>20</b>
						V String		
			GAP	Normal Route		I string	250	<b>21</b>
						V String		
			CFCC	Forest		V String	150	<b>13</b>
						Tension		
			ACSS	Forest		V String	150	<b>16</b>
						Tension		
		GAP	Forest		V String	150	<b>14</b>	
					Tension			
	CFCC	Urban/ Populated		V String	100	<b>12</b>		
				Tension				
	ACSS	Urban/ Populated		V String	100	<b>14</b>		
				Tension				
	GAP	Urban/ Populated		V String	100	<b>13</b>		
				Tension				

**Note:**

- Conductors Diameter as given in Table-2 has been considered.
- Carbon Fiber Composite Core (CFCC); Sag is calculated at 180 °C.
- Aluminium Conductor Steel Supported (ACSS): Sag is calculated at 250 °C.
- GZTACSR: Gap-type Aluminium Conductor Steel Reinforced (GAP conductor); Sag is calculated at 210 °C.
- Sag for the above conductors are as per design mentioned in CEA's Guidelines for Rationalised use of High Performance Conductors.

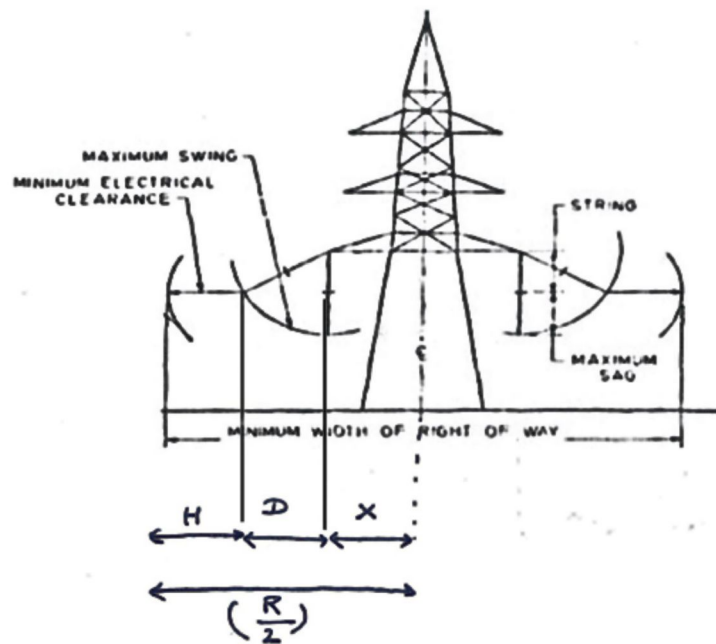
- f) *All the electrical clearances and safety parameters shall be meet within the RoW as per relevant standards and CEA regulations.*

## Annexure-I

## Guidelines for calculation of RoW width

1. The following formula for calculating RoW width may be followed:

(i). The schematic representation of Right of Way width is as under



(ii). Formula for calculating Right of Way width (R) is

$$R = 2*(H+D+X) \text{ (in m)}$$

Where,

**H:** Horizontal clearance (2.0 m+0.3 m for every additional 33 kV or part thereof) in (m)

**X:** Horizontal distance of Conductor attachment point from centre of Pole in (m)

**D:** Horizontal displacement from Conductor attachment point due to swing (m)

and, 
$$D = (I+S)* \text{Sin} (\theta)$$

Where,

$\theta$  = Swing angle (degrees)

I = Suspension/Insulator drop/length (m)

S = Sag (m)



2. In urban areas due to ROW constraints, transmission service providers/utilities are using lattice/Pole Structures with single side cross arm. The ROW width (R) for transmission lines with single side cross arm pole structures may be calculated using following formula:

$$\mathbf{R = 2*(H+D)} \qquad \text{If } (H+D > X)$$

$$\mathbf{R = H+D+X} \qquad \text{If } (H+D < X)$$

3. While calculating RoW width, all the relevant standards, Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022 and Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023 shall be followed. All the electrical clearances and safety parameters shall be met within the RoW as per relevant standards and CEA regulations.

**Table 1 (RIGHT OF WAY CALCULATION FOR NORMAL ROUTE, FOREST AREA, URBAN AREA / POPULATED AREA / APPROACH SECTION NEAR SUBSTATION FOR POLE STRUCTURES with ACSR Conductor)**

Sn o.	Volta ge Level	Config uration	Conductor type	Terrain	Design Span(m)	String Type	sag(m)	Suspension Polymer Insulator String Length/Drop (m)	Horizontal clearance (2.0m+0.3 M for every additional 33 kV or part thereof) (m) (H)	Horizontal distance of Conductor attachment point from centre of Pole (m) (X)	Horizontal displacement from Conductor attachment point due to swing (m) (D)	ROW width (m)
1	765k V S/C	Vertical DELTA	ACSR BERSIMIS	Normal route without constraint	250	Tension	6.772	0	9	10.1	3.9	46
				Forest area Urban area/Populated area/approach section near substation								
				Normal route without constraint	250	I STRING	6.772	7.6	9	9	8.2	52
				-								
				-								

				Normal route without constraint Forest area Urban area/Populated area/approach section near substation	250	V STRING	6.772	0	9	7.5	3.9	41
2	400k V D/C	Vertical	ACSR MOOSE	Normal route without constraint Forest area Urban area/Populated area/approach section near substation	250	Tension	6.078	0	5.6	6.25	3.5	31
				Normal route without constraint Forest area Urban area/Populated area/approach section near substation	250	I STRING	6.078	4.5	5.6	6.5	6.1	36
				Normal route without constraint Forest area	250	V STRING	6.078	0	5.6	5.5	3.5	29

				Urban area/Populated area/approach section near substation								
3	220k V D/C	Vertical	ACSR ZEBRA	Normal route without constraint	350	Tension	10.553	0	3.8	4.75	6.1	29
						I STRING	10.553	2.5	3.8	4.2	7.5	31
						V STRING	10.553	0	3.8	4.2	6.1	28
				Forest area	250	Tension	6.079	0	3.8	4.75	3.5	24
						I STRING	6.079	2.5	3.8	4.2	4.9	26
						V STRING	6.079	0	3.8	4.2	3.5	23
				Urban area/Populated area/approach section near substation	200	Tension	4.297	0	3.8	4.75	2.5	22
						V STRING	4.297	2.5	3.8	4.2	3.9	24
						V STRING	4.297	0	3.8	4.2	2.5	21
4	132 kV D/C	Vertical	ACSR PANTHER	Normal route without constraint	325	Tension	8.338	0	2.9	4.0	4.8	23
						I STRING	8.338	2.3	2.9	3.5	6.1	25
						V STRING	8.338	0	2.9	3.5	4.8	22
				Forest area	200	Tension	3.844	0	2.9	4.0	2.2	18

						I STRING	3.844	2.3	2.9	3.5	3.5	20
						V STRING	3.844	0	2.9	3.5	2.2	17
				Urban area/Populated area/approach section near substation	150	Tension	2.491	0	2.9	4.0	1.4	17
						V STRING	2.491	2.3	2.9	3.5	2.7	18
						V STRING	2.491	0	2.9	3.5	1.4	16
5	110 kV D/C	Vertical	ACSR Lynx	Urban area/Populated area/approach section near substation	150	Tension	2.025	0	2.9	3	1.2	14
						I STRING	2.025	2.3	2.9	2.8	2.5	16
						V STRING	2.025	0	2.9	2.8	1.2	14

**Table 2 (RIGHT OF WAY CALCULATION FOR NORMAL ROUTE, FOREST AREA, URBAN AREA / POPULATED AREA / APPROACH SECTION NEAR SUBSTATION FOR POLE STRUCTURES with HTLS Conductor)**

*Carbon Fiber Composite Core (CFCC); Sag is calculated at 180 °C.*

*Aluminium Conductor Steel Supported (ACSS): Sag is calculated at 250 °C.*

*GZTACSR: Gap-type Aluminium Conductor Steel Reinforced (GAP conductor); Sag is calculated at 210 °C.*

**Note:** Sag for the above conductors are as per design mentioned in CEA's Guidelines for Rationalised use of High Performance Conductors

S n o	Voltage Level	Config uration	Conduc tor type	Terrain	Design Span(m)	String Type	sag(m)	Suspensi on Polymer Insulator String Length/Dr op (m)	Horizontal clearance (2.0m+0.3 M for every additional 33 kV or part thereof) (m) (H)	Horizontal distance of Conductor attachment point from centre of Pole (m) (X)	Horizontal displacement from Conductor attachment point due to swing (m) (D)	ROW width (m)
1	400kV D/C	Vertical	CFCC	Normal route without constraint	250	Tension	4.26	0	5.6	6.25	2.4	29
				Forest area Urban area/Populated area/approach section near substation								
				Normal route without constraint	250	I STRING	4.26	4.5	5.6	6.5	5.0	34
				-								
				-								

				Normal route without constraint	250	V String	4.26	0	5.6	5.5	2.4	27
				Forest area								
				Urban area/Populated area/approach section near substation								
2	400kV D/C	Vertical	ACSS	Normal route without constraint	250	Tension	8.2	0	5.6	6.25	4.7	33
				Forest area								
				Urban area/Populated area/approach section near substation								
			ACSS	Normal route without constraint	250	I STRING	8.2	4.5	5.6	6.5	7.3	39
				-								
				-								
			ACSS	Normal route without constraint	250	V String	8.2	0	5.6	5.5	4.7	32
				Forest area								
				Urban area/Populated area/approach section near substation								
3	400kV D/C	Vertical	GAP	Normal route without constraint	250	Tension	6.48	0	5.6	6.25	3.7	31
				Forest area								

				Urban area/Populated area/approach section near substation								
				Normal route without constraint	250	I STRING	6.48	4.5	5.6	6.5	6.3	37
				-								
				Normal route without constraint	250	V String	6.48	0	5.6	5.5	3.7	30
				Forest area								
				Urban area/Populated area/approach section near substation								
4	220kV D/C	Vertical		Normal route without constraint	350	Tension	5.97	0	3.8	4.75	3.4	24
						I STRING	5.97	2.8	3.8	4.2	5.0	26
						V STRING	5.97	0.7	3.8	4.2	3.8	24
				Forest area	250	Tension	3.09	0	3.8	4.75	1.8	21
						I STRING	3.09	2.8	3.8	4.2	3.4	23
						V STRING	3.09	0.7	3.8	4.2	2.2	20
			CFCC	Urban area/Populated area/approach section near substation	200	Tension	2.02	0	3.8	4.75	1.2	19
						I STRING	2.02	2.8	3.8	4.2	2.8	22



						V STRING	2.02	0.7	3.8	4.2	1.6	19
5	220kV D/C	Vertical	ACSS	Normal route without constraint	350	Tension	11.72	0	3.8	4.75	6.7	31
						I STRING	11.72	2.8	3.8	4.2	8.3	33
						V String	11.72	0.7	3.8	4.2	7.1	30
				Forest area	250	Tension	7.18	0	3.8	4.75	4.1	25
						I STRING	7.18	2.8	3.8	4.2	5.7	27
						V String	7.18	0	3.8	4.2	4.1	24
				Urban area/Populated area/approach section near substation	200	Tension	5.26	0	3.8	4.75	3.0	23
						I STRING	5.26	2.8	3.8	4.2	4.6	25
						V String	5.26	0	3.8	4.2	3.0	22
6	220kV D/C	Vertical	GAP	Normal route without constraint	350	Tension	10.08	0	3.8	4.75	5.8	29
						I STRING	10.08	2.8	3.8	4.2	7.4	31
						V String	10.08	0	3.8	4.2	5.8	28
				Forest area	250	Tension	5.69	0	3.8	4.75	3.3	24
						I STRING	5.69	2.8	3.8	4.2	4.9	26
						V String	5.69	0	3.8	4.2	3.3	23
				Urban area/Populated area/approach section near substation	200	Tension	3.91	0	3.8	4.75	2.2	22
						I STRING	3.91	2.8	3.8	4.2	3.8	24
						V String	3.91	0	3.8	4.2	2.2	20

7	132 kV D/C	Vertical	CFCC	Normal route without constraint	320	Tension	5.07	0	2.9	4.0	2.9	20
						I STRING	5.07	2.6	2.9	3.5	4.4	22
						V STRING	5.07	0	2.9	3.5	2.9	19
				Forest area	200	Tension	2	0	2.9	4.0	1.1	16
						I STRING	2	2.6	2.9	3.5	2.6	18
						V STRING	2	0	2.9	3.5	1.1	15
				Urban area/Populated area/approach section near substation	150	Tension	1.14	0	2.9	4.0	0.7	15
						I STRING	1.14	2.6	2.9	3.5	2.1	17
						V STRING	1.14	0	2.9	3.5	0.7	14
8	132 kV D/C	Vertical	ACSS	Normal route without constraint	320	Tension	9.16	0	2.9	4.0	5.3	24
						I STRING	9.16	2.6	2.9	3.5	6.7	26
						V String	9.16	0	2.9	3.5	5.3	23
				Forest area	200	Tension	4.73	0	2.9	4.0	2.7	19
						I STRING	4.73	2.6	2.9	3.5	4.2	21
						V String	4.73	0	2.9	3.5	2.7	18
				Urban area/Populated area/approach section near substation	150	Tension	3.2	0	2.9	4.0	1.8	17
						I STRING	3.2	2.6	2.9	3.5	3.3	19
						V String	3.2	0	2.9	3.5	1.8	16

9	132 kV D/C	Vertical	GAP	Normal route without constraint	320	Tension	8.32	0	2.9	4.0	4.8	23
						I STRING	8.32	2.6	2.9	3.5	6.3	25
						V String	8.32	0	2.9	3.5	4.8	22
				Forest area	200	Tension	3.91	0	2.9	4.0	2.2	18
						I STRING	3.91	2.6	2.9	3.5	3.7	20
						V String	3.91	0	2.9	3.5	2.2	17
				Urban area/Populated area/approach section near substation	150	Tension	2.44	0	2.9	4.0	1.4	17
						I STRING	2.44	2.6	2.9	3.5	2.9	19
						V String	2.44	0	2.9	3.5	1.4	16

**Table 3 (RIGHT OF WAY CALCULATION FOR NORMAL ROUTE, FOREST AREA, URBAN AREA / POPULATED AREA / APPROACH SECTION NEAR SUBSTATION FOR LATTICE STRUCTURES with HTLS conductor)**

Carbon Fiber Composite Core (CFCC); Sag is calculated at 180 °C.

Aluminium Conductor Steel Supported (ACSS): Sag is calculated at 250 °C.

GZTACSR: Gap-type Aluminium Conductor Steel Reinforced (GAP conductor); Sag is calculated at 210 °C.

Note: Sag for the above conductors are as per design mentioned in CEA's Guidelines for Rationalised use of High Performance Conductors

S. No.	Voltage level (kV)	Ckt type	Configuration	Conductor type	String Type	Suspension Polymer Insulator String Length/Drop (m)	Swing angle	Terrain	Design Span (m)	Horizontal clearance (2.0m+0.3 M for every additional 33 kV or part thereof) (m) (H)	Sag at Max continuous operating Temp Deg. C (in m)	Horizontal displacement from Conductor attachment point due to swing (m) (D)	Maximum Horizontal distance of Conductor attachment point from centre of Pole (m) (X)	ROW width (m)	RoW Considered	
1	400	DC	Vertical	CFCC	I string	4.00	35	Normal Route	400	5.60	<b>10.65</b>	8.40	7.50	<b>43</b>	<b>43</b>	
2					V	0.00	35			5.60	<b>10.65</b>	6.11	6.00			<b>35</b>
3					Tension	0.00	35			5.60	<b>10.65</b>	6.11	9.70			<b>43</b>
4				ACSS	I string	4.00	35			5.60	<b>16.60</b>	11.82	7.50	<b>50</b>		<b>50</b>
5					V	0.00	35			5.60	<b>16.60</b>	9.52	6.00	<b>42</b>		
6					Tension	0.00	35			5.60	<b>16.60</b>	9.52	9.70	<b>50</b>		
7				GAP	I string	4.00	35			5.60	<b>14.67</b>	10.71	7.50	<b>48</b>		<b>48</b>
8					V	0.00	35			5.60	<b>14.67</b>	8.41	6.00	<b>40</b>		
9					Tension	0.00	35			5.60	<b>14.67</b>	8.41	9.70	<b>47</b>		
10	220	DC	Vertical	CFCC	I string	2.50	35	Normal Route	350	3.80	<b>5.97</b>	4.86	4.60	<b>27</b>	<b>27</b>	
11					V	0.00	35			3.80	<b>5.97</b>	3.42	4.00	<b>22</b>		

12					Tension	0.00	35			3.80	<b>5.97</b>	3.42	5.70	<b>26</b>	
13				ACSS	I string	2.50	35			3.80	<b>11.72</b>	8.16	4.60	<b>33</b>	<b>33</b>
14			V		0.00	35			3.80	<b>11.72</b>	6.72	4.00	<b>29</b>		
15			Tension		0.00	35			3.80	<b>11.72</b>	6.72	5.70	<b>32</b>		
16			I string		2.50	35			3.80	<b>10.08</b>	7.22	4.60	<b>31</b>		
17			GAP	V	0.00	35			3.80	<b>10.08</b>	5.78	4.00	<b>27</b>	<b>31</b>	
18				Tension	0.00	35			3.80	<b>10.08</b>	5.78	5.70	<b>31</b>		
19				I string	2.30	35			2.90	<b>5.07</b>	4.23	3.90	<b>22</b>		
20			CFCC	V	0.00	35			2.90	<b>5.07</b>	2.91	3.50	<b>19</b>	<b>22</b>	
21				Tension	0.00	35			2.90	<b>5.07</b>	2.91	5.30	<b>22</b>		
22				I string	2.30	35			2.90	<b>9.16</b>	6.57	3.90	<b>27</b>		
23	132	DC	Vertical	ACSS	V	0.00	35	Normal Route	320	2.90	<b>9.16</b>	5.25	3.50	<b>23</b>	<b>27</b>
24					Tension	0.00	35			2.90	<b>9.16</b>	5.25	5.30	<b>27</b>	
25					I string	2.30	35			2.90	<b>8.32</b>	6.09	3.90	<b>26</b>	
26				GAP	V	0.00	35			2.90	<b>8.32</b>	4.77	3.50	<b>22</b>	<b>26</b>
27					Tension	0.00	35			2.90	<b>8.32</b>	4.77	5.30	<b>26</b>	
28					I string	1.90	35			2.30	<b>3.31</b>	2.99	2.50	<b>16</b>	
29				66	DC	Vertical	CFCC			V	0.00	35	Normal Route	250	2.30
30	Tension	0.00	35					2.30	<b>3.31</b>	1.90	3.50	<b>15</b>			
31	I string	1.90	35					2.30	<b>6.98</b>	5.09	2.50	<b>20</b>			
32	ACSS	V	0.00				35	2.30	<b>6.98</b>	4.00	2.50	<b>18</b>			<b>20</b>
33		Tension	0.00				35	2.30	<b>6.98</b>	4.00	3.50	<b>20</b>			
34		I string	1.90				35	2.30	<b>8.32</b>	5.86	2.50	<b>21</b>			
35	GAP	V	0.00	35	2.30	<b>8.32</b>	4.77	2.50	<b>19</b>	<b>21</b>					
36		Tension	0.00	35	2.30	<b>8.32</b>	4.77	3.50	<b>21</b>						
37	400	DC	Vertical	CFCC	I string	4.00	35	Forest	300	5.60	<b>6.15</b>	5.82	7.50	<b>38</b>	<b>38</b>

38					V	0.00	35			5.60	6.15	3.53	6.00	30	
39					Tension	0.00	35			5.60	6.15	3.53	9.70	38	
40				ACSS	I string	4.00	35			5.60	10.70	8.43	7.50	43	43
41					V	0.00	35			5.60	10.70	6.14	6.00	35	
42					Tension	0.00	35			5.60	10.70	6.14	9.70	43	
43				GAP	I string	4.00	35			5.60	8.87	7.38	7.50	41	41
44					V	0.00	35			5.60	8.87	5.09	6.00	33	
45					Tension	0.00	35			5.60	8.87	5.09	9.70	41	
46	220	DC	Vertical	CFCC	I string	2.50	35	Forest	300	3.80	4.42	3.97	4.60	25	24
47					V	0.00	35			3.80	4.42	2.54	4.00	21	
48					Tension	0.00	35			3.80	4.42	2.54	5.70	24	
49				ACSS	I string	2.50	35			3.80	9.34	6.79	4.60	30	30
50					V	0.00	35			3.80	9.34	5.36	4.00	26	
51					Tension	0.00	35			3.80	9.34	5.36	5.70	30	
52				GAP	I string	2.50	35			3.80	7.75	5.88	4.60	29	28
53					V	0.00	35			3.80	7.75	4.45	4.00	24	
54	Tension	0.00	35		3.80	7.75	4.45	5.70	28						
55	132	DC	Vertical	CFCC	I string	2.30	35	Forest	200	2.90	2.00	2.47	3.90	19	19
56					V	0.00	35			2.90	2.00	1.15	3.50	15	
57					Tension	0.00	35			2.90	2.00	1.15	5.30	19	
58				ACSS	I string	2.30	35			2.90	4.73	4.03	3.90	22	22
59					V	0.00	35			2.90	4.73	2.71	3.50	18	
60					Tension	0.00	35			2.90	4.73	2.71	5.30	22	
61				GAP	I string	2.30	35			2.90	3.91	3.56	3.90	21	21
62					V	0.00	35			2.90	3.91	2.24	3.50	17	
63	Tension	0.00	35		2.90	3.91	2.24	5.30	21						

64	66	DC	Vertical	CFCC	I string	1.90	35	Forest	150	2.30	<b>1.24</b>	1.80	2.50	<b>13</b>	<b>13</b>
65					V	0.00	35			2.30	<b>1.24</b>	0.71	2.50	<b>11</b>	
66					Tension	0.00	35			2.30	<b>1.24</b>	0.71	3.50	<b>13</b>	
67				ACSS	I string	1.90	35			2.30	<b>3.44</b>	3.06	2.50	<b>16</b>	<b>16</b>
68					V	0.00	35			2.30	<b>3.44</b>	1.97	2.50	<b>14</b>	
69					Tension	0.00	35			2.30	<b>3.44</b>	1.97	3.50	<b>16</b>	
70				GAP	I string	1.90	35			2.30	<b>2.44</b>	2.49	2.50	<b>15</b>	<b>14</b>
71					V	0.00	35			2.30	<b>2.44</b>	1.40	2.50	<b>12</b>	
72					Tension	0.00	35			2.30	<b>2.44</b>	1.40	3.50	<b>14</b>	
73	400	DC	Vertical	CFCC	I string	4.00	35	Urban/P opulated	250	5.60	<b>4.26</b>	4.74	7.50	<b>36</b>	<b>35</b>
74					V	0.00	35			5.60	<b>4.26</b>	2.44	6.00	<b>28</b>	
75					Tension	0.00	35			5.60	<b>4.26</b>	2.44	9.70	<b>35</b>	
76				ACSS	I string	4.00	35			5.60	<b>8.20</b>	7.00	7.50	<b>40</b>	<b>40</b>
77					V	0.00	35			5.60	<b>8.20</b>	4.70	6.00	<b>33</b>	
78					Tension	0.00	35			5.60	<b>8.20</b>	4.70	9.70	<b>40</b>	
79				GAP	I string	4.00	35			5.60	<b>6.48</b>	6.01	7.50	<b>38</b>	<b>38</b>
80					V	0.00	35			5.60	<b>6.48</b>	3.72	6.00	<b>31</b>	
81					Tension	0.00	35			5.60	<b>6.48</b>	3.72	9.70	<b>38</b>	
82	220	DC	Vertical	CFCC	I string	2.50	35	Urban/P opulated	250	3.80	<b>3.09</b>	3.21	4.60	<b>23</b>	<b>23</b>
83					V	0.00	35			3.80	<b>3.09</b>	1.77	4.00	<b>19</b>	
84					Tension	0.00	35			3.80	<b>3.09</b>	1.77	5.70	<b>23</b>	
85				ACSS	I string	2.50	35			3.80	<b>7.18</b>	5.55	4.60	<b>28</b>	<b>27</b>
86					V	0.00	35			3.80	<b>7.18</b>	4.12	4.00	<b>24</b>	
87					Tension	0.00	35			3.80	<b>7.18</b>	4.12	5.70	<b>27</b>	
88				GAP	I string	2.50	35			3.80	<b>5.69</b>	4.70	4.60	<b>26</b>	<b>26</b>
89					V	0.00	35			3.80	<b>5.69</b>	3.26	4.00	<b>22</b>	

90					Tension	0.00	35			3.80	<b>5.69</b>	3.26	5.70	<b>26</b>	
91	132	DC	Vertical	CFCC	I string	2.30	35	Urban/Populated	150	2.90	<b>1.14</b>	1.97	3.90	<b>18</b>	<b>18</b>
92					V	0.00	35			2.90	<b>1.14</b>	0.65	3.50	<b>14</b>	
93					Tension	0.00	35			2.90	<b>1.14</b>	0.65	5.30	<b>18</b>	
94				ACSS	I string	2.30	35			2.90	<b>3.20</b>	3.15	3.90	<b>20</b>	<b>20</b>
95					V	0.00	35			2.90	<b>3.20</b>	1.84	3.50	<b>16</b>	
96					Tension	0.00	35			2.90	<b>3.20</b>	1.84	5.30	<b>20</b>	
97				GAP	I string	2.30	35			2.90	<b>2.44</b>	2.72	3.90	<b>19</b>	<b>19</b>
98					V	0.00	35			2.90	<b>2.44</b>	1.40	3.50	<b>16</b>	
99					Tension	0.00	35			2.90	<b>2.44</b>	1.40	5.30	<b>19</b>	
100	66	DC	Vertical	CFCC	I string	1.90	35	Urban/Populated	100	2.30	<b>0.56</b>	1.41	2.50	<b>12</b>	<b>12</b>
101					V	0.00	35			2.30	<b>0.56</b>	0.32	2.50	<b>10</b>	
102					Tension	0.00	35			2.30	<b>0.56</b>	0.32	3.50	<b>12</b>	
103				ACSS	I string	1.90	35			2.30	<b>2.00</b>	2.24	2.50	<b>14</b>	<b>14</b>
104					V	0.00	35			2.30	<b>2.00</b>	1.15	2.50	<b>12</b>	
105					Tension	0.00	35			2.30	<b>2.00</b>	1.15	3.50	<b>14</b>	
106				GAP	I string	1.90	35			2.30	<b>1.24</b>	1.80	2.50	<b>13</b>	<b>13</b>
107					V	0.00	35			2.30	<b>1.24</b>	0.71	2.50	<b>11</b>	
108	Tension	0.00	35		2.30	<b>1.24</b>	0.71	3.50	<b>13</b>						



## Appendix-I

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भारत सरकार/Government of India  
 विद्युत मंत्रालय/Ministry of Power  
 केन्द्रीय विद्युत प्राधिकरण/Central Electricity Authority  
 विद्युत प्रणाली अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग  
 Power System Engineering & Technology Development Division

Date: 23.08.2023

सेवा में,

&lt;As per addresses&gt;

विषय: Minutes of 1st Meeting of Committee for calculation of Right-Of-Way (RoW) for other technological options held on 22.08.2023 .

महोदया/महोदय ,

This has reference to the meeting of the Committee for calculation of Right-Of-Way (ROW) for other technological options held under the chairmanship of CE, PSETD through video conferencing on 22.08.2023.

The Minutes of the meeting are enclosed for information and further necessary action at your end.

भवदीय/Regards

(भंवर सिंह मीना /Bhanwar Singh Meena)

निदेशक/Director &  
Member-Convenor of committeeCopy to:

SA to Member (PS)

I/29895/2023

File No.CEA-PS-14-86/2/2019-PSETD Division

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**Minutes of 1st meeting of the Committee for calculation of Right-of-Way (RoW) for other technological options held under the chairmanship of CE, PSETD through video conferencing on 22.08.2023**

\*\*\*

The list of participants of the meeting is attached as Annexure-I

1. Chief Engineer, PSETD welcomed all the participants and briefed about the agenda of the meeting. He informed that CEA has already defined Right of Way (RoW) width for major combinations of voltage and tower configurations in SCHEDULE-VII in Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022. However, various representations are being received in CEA in respect of use of various technological options like insulated cross arm, monopole, etc., which can further reduce the Right of Way (RoW) of transmission lines. He highlighted that CEA had also circulated a concept paper on the insulated cross arm which would reduce the RoW bottlenecks in the construction of overhead transmission lines, however, it is learnt that the land acquisition authorities are not accepting the payment of Land compensation for the reduced RoW width with these technological options due to the non-inclusion of these options in CEA regulation.
2. He further stated that in view of the above, a need has been felt to define RoW width for all combinations of the available technological solutions. However, during the process of defining revised RoW width, the general safety requirements including minimum live metal clearance, ground clearance and minimum mid-span separation between earth wire and conductor, shall be kept as per regulations. Thereafter he requested all the participants to give suggestions on the methodologies to adopt for the reduction of RoW.
3. The Representative from KPTCL suggested that in place of specifying the RoW for every combination an empirical formula may be provided and based on the technical parameters of the line, the utilities may calculate the RoW as per the formula. He further suggested following formula for calculation of the RoW.

$$\text{Right of Way (RoW)} = 2x \{ (\text{Cross arm spread from Tower Centre}) + [(\text{suspension string length} + \text{Maximum Conductor Sag}) \times \text{Sin}(\phi)] + (\text{Minimum Horizontal Clearance as per CEA Regulations}) \}$$

Where  $\phi$  - Maximum Deflection Angle based on Wind Zone

4. Representatives from POWERGRID, PTCUL, GETCO and M/s Shemar pointed out that different utilities are having different tower designs and are falling under different wind zones and hence the RoW calculated on basis of the empirical formula may vary from utility to utility. The implementation of transmission projects with non-uniform RoW width will be difficult to manage at the site and a uniform RoW may be stated by the committee for all the possible configurations.

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5. Chief Engineer (PSETD), CEA highlighted that depending upon the various possible type of towers, configuration of towers, conductor type, insulator string type, type of cross arms, design span, terrain, etc. the total number of RoW combinations will be quite large and it will be a cumbersome task to tabulate all possible types of combinations. Therefore, he requested all the stakeholders and private developers to assist in finalization of the RoW values with possible numbers of combinations.
6. The representatives from different utilities agreed to the suggestion given by CE, PSETD and Representative from M/s. Sterlite, M/s. Shemar and KPTCL agreed to work in conjunction to come out with a draft table containing all the possible combinations of RoW width.
7. Regarding the reduction of RoW values with the use of Monopoles structures, Committee decided to co-opt members from M/s. Valmont Structures and M/s. Bajaj Electricals as representative of Monopole manufacturers.
8. Chief Engineer, PSETD requested all the utilities to submit the table with all possible combinations of RoW width at the earliest and suggested that the same may be circulated among the committee members for examination/comments, before convening the next committee meeting. He also requested the committee members to provide suggestions/comments on the empirical formula suggested by M/s KPTCL.

The meeting ended with vote of thanks.

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**Addresses:**

S No	Name	Address	Email
1.	Managing Director	KPTCL	cmd@powergrid.in
2.	Director (Operations)	MSETCL	dirop@mahatransco.in
3.	Director General,	EPTA	Dg.epta@epta.in epta.dg@gmail.com
4.	Chief Engineer	CEI, CEA	cea-eidivision@gov.in rishika@nic.in
5.	Chief Engineer	PCD, CEA	cepcd.cea@gov.in
6.	Lalit Kumar, SE (Line Design), PTCUL	PTCUL	lalit_kumar@ptcul.org; md@ptcul.org
7.	Shri K. H. Rathod, I/ C CE (Project)	GETCO	aceproject.getco@gebmail.com md.getco@gebmail.com
8.	Shri Nitesh Kumar Sinha, Sr.DGM (Engg- TL),	Powergrid	nksinha@powergrid.in cmd@powergrid.in
9.	Shri Ram Kumar	DTL	dgmplanning.dtl2016@gmail.com md@dtl.gov.in
10.	Shri Mayank Jaggi	CTC Global	mjaggi@ctcglobal.com
11.	Shri Jeetendra Bisht	Sterlite	Jeetendra.bisht@sterlite.com
12.	Shri Sudhir Nayak	Indigrid	sudhir.nayak@indigrid.com
13.	Shri <u>Jaydeep Ganguly</u>	Tokyo Rope international Inc	jaydeep.ganguly@tokyorope.jp

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**Annexure-I****List of Participants:****CEA**

1. Shri Ramesh Kumar, Chief Engineer, PSETD Division
2. Smt. Rishika Sharan, Chief Electrical Inspector
3. Shri Bhanwar Singh Meena, Director, PSETD Division
4. Shri. Rajesh Kumar Tiwari, Deputy Director, CEI Division
5. Shri Pankaj Kumar Verma, Deputy Director, PSETD Division
6. Shri Mohit Mudgal, Deputy Director, PSETD Division
7. Shri Rahul Singh, Deputy Director, CEI Division
8. Shri Mukul Kumar, RIO North, CEI division
9. Shri Nishant Chohla, Assistant Director, PSETD division

**POWERGRID**

1. Shri Nitesh Kumar Sinha, Sr.DGM (Engg-TL),

**GETCO**

1. Shri. A. J. Chavda, Chief Engineer

**PTCUL**

1. Shri. Kundan Rathod, Chief Engineer
2. Shri Lalit Kumar

**KPTCL**

1. Shri. Syed Mansur Hussain, Superintendent Engineer

**M/s. Sterlite Power**

1. Shri Jeetendra Bisht, VP, Sterlite Power
2. Shri Pawan Pitra, AVP, Sterlite Power
3. Shri R. Ananthakumar, AVP, Sterlite Power
4. Shri Md Sharique Afzal, Sterlite Power
5. Prasad S

**M/s. Adani Power**

1. Shri Narendra Kumar Ojha, Manager, Adani

**M/s Indgrid**

1. Shri. Sudhir Nayak, Indgrid

**M/s Renew Power**

1. Shri. Mohit Jain, Renew
2. Shri. Anuj Jain, Renew

**M/s. Tokyo Rope international Inc**

1. Shri. Jaydeep Ganguly

**M/s Shemar**

1. Shri. Rajas

## Appendix-II

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File No.CEA-PS-14-86/2/2019-PSETD Division

भारत सरकार  
GOVERNMENT OF INDIA

सत्यमेव जयते



भारत सरकार/Government of India

विद्युत मंत्रालय/Ministry of Power

केन्द्रीय विद्युत प्राधिकरण/Central Electricity Authority

विद्युत प्रणाली अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग

Power System Engineering &amp; Technology Development Division

Date: 30.11.2023

सेवा में,

&lt;as per addresses &gt;

**विषय: Minutes of 2nd e-meeting of Committee for calculation of reduction of Right-Of-Way (ROW) width through technological options – Reg.**

The 2<sup>nd</sup> e-meeting of the committee constituted under the chairmanship of Chief Engineer (PSETD), CEA was held on 31.10.2023 at 12:00 PM through video conferencing to deliberate on the matter for calculation of reduction of Right-Of-Way (RoW) width through available technological options. The minutes of the meeting are attached for information and necessary action.

संलग्न : उपरोक्त

भवदीय,

(भंवर सिंह मीना /Bhanwar Singh Meena)  
निदेशक/Director

Copy to:

- (I) PS to Chairperson, CEA
- (II) PS to Member (Power System), CEA
- (III) CE, PSPA-I, CEA
- (IV) CE, PSPA-II, CEA

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**Addresses:**

S No	Name	Address	Email
1.	Managing Director	KPTCL	<a href="mailto:md@kptcl.com">md@kptcl.com</a>
2.	Director (Operations)	MSETCL	<a href="mailto:dirop@mahatransco.in">dirop@mahatransco.in</a>
3.	Managing Director	PTCUL	<a href="mailto:md@ptcul.org">md@ptcul.org</a>
4.	Director General,	EPTA	<a href="mailto:Dg.epta@epta.in">Dg.epta@epta.in</a> <a href="mailto:epta.dg@gmail.com">epta.dg@gmail.com</a>
5.	Chief Engineer	CEI, CEA	<a href="mailto:cea-eidivision@gov.in">cea-eidivision@gov.in</a> ; <a href="mailto:rishika@nic.in">rishika@nic.in</a>
6.	Chief Engineer	PCD, CEA	<a href="mailto:cepcd.cea@gov.in">cepcd.cea@gov.in</a>
7.	Shri K. H. Rathod, I/C CE (Project)	GETCO	<a href="mailto:aceproject.getco@gebmil.com">aceproject.getco@gebmil.com</a> <a href="mailto:md.getco@gebmil.com">md.getco@gebmil.com</a>
8.	Shri Nitesh Kumar Sinha, Sr.DGM (Engg-TL),	Powergrid	<a href="mailto:nksinha@powergrid.in">nksinha@powergrid.in</a> <a href="mailto:cmd@powergrid.in">cmd@powergrid.in</a>
9.	Shri Mayank Jaggi	CTC Global	<a href="mailto:mjaggi@ctcglobal.com">mjaggi@ctcglobal.com</a>
10.	Shri Jeetendra Bisht	Sterlite	<a href="mailto:Jeetendra.bisht@sterlite.com">Jeetendra.bisht@sterlite.com</a>
11.	Shri Sudhir Nayak	Indigrid	<a href="mailto:sudhir.nayak@indigrid.com">sudhir.nayak@indigrid.com</a>
12.	Shri Jaydeep Ganguly	Tokyo Rope international Inc	<a href="mailto:jaydeep.ganguly@tokyorope.jp">jaydeep.ganguly@tokyorope.jp</a>
13.	Shri Ram Kumar	DTL	<a href="mailto:dgmplanning.dtl2016@gmail.com">dgmplanning.dtl2016@gmail.com</a> <a href="mailto:md@dtl.gov.in">md@dtl.gov.in</a>
14.	Shri Asis Panda Shri Sreedhar Reddy	Valmont Structures Private Limited	<a href="mailto:asis.panda@valmont.com">asis.panda@valmont.com</a> <a href="mailto:G.Reddy@valmont.com">G.Reddy@valmont.com</a>
15.	Shri Kailash Deshmukh	M/s Bajel Projects Ltd.	<a href="mailto:monal.wagh@bajelprojects.com">monal.wagh@bajelprojects.com</a> <a href="mailto:pradeep.mv@bajelprojects.com">pradeep.mv@bajelprojects.com</a>

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	Shri Pradeep M V		<a href="mailto:Kailash.deshmukh@bajelprojects.com">Kailash.deshmukh@bajelprojects.com</a>
	Shri Monal Wagh		

3



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**Minutes of 2<sup>nd</sup> e-meeting of the committee constituted under the chairmanship of Chief Engineer (PSETD), CEA was held on 31.10.2023 at 12:00 PM through video conferencing to deliberate on the matter for calculation of reduction of Right-Of-Way (RoW) width through available technological options**

List of Participants is attached as Annexure-I

1. At the outset, Chief Engineer (PSETD), CEA welcomed all the participants and briefed that as decided in the previous meeting, the inputs regarding the calculation of the Right of Way (RoW) width was provided by the designated committee members, and the same were circulated to all other members for examinations and comments/inputs. He further requested participants present during the meeting to provide their suggestions/comments/views on the calculations of RoW provided by committee members.
2. Representative from M/s Powergrid highlighted following points:
  - a. The design spans for 220kV forest area is not in line with CEA Regulations.
  - b. Swings of suspension Insulator and conductor may be fixed as 35 degrees irrespective of voltage level/Span/Wind Zone to have uniformity in calculation of RoW. There is no need to vary swing angles based on the given parameters.
  - c. He suggested that RoW width calculations for "V string and Insulated Cross Arm type insulators may be clubbed together whereas RoW width calculations for "I" string insulators may be done separately.
  - d. RoW widths with tension insulator strings may not be calculated separately as it may further increase the confusion/non-uniformity of RoW for Transmission line.
  - e. As the width of lattice tower structures is more in comparison to Pole structures, RoW width for lattice towers may be indicated separately, and RoW width requirement for Monopole, Inverted cross arm, twin monopole structures etc. may be clubbed together to remove ambiguity.
  - f. To avoid multiple set of RoW widths at same voltage level, RoW width considering one type of conductor, i.e conventional type conductor for specific voltage level, may be specified. And RoW calculation for multiple type of conductors for that voltage level may be avoided.
  - g. The RoW width calculated shall be valid for plain area i.e. upto altitude 1000 m height above sea level.
  - h. The RoW width to be considered for a particular transmission line passing through the various types of routes, (i.e. normal route, forest, urban/populated/approach section near substation) may be clearly indicated in the report.
3. Representative from M/s. Sterlite Power stated the following:
  - a. Agreed with Powergrid suggestion for combining the calculations of RoW for ICA and V string configurations.
  - b. Regarding conductors, a separate calculation of RoW with conventional conductors can be placed. For other conductors, matter may be discussed separately.
  - c. For the calculation of RoW, values of various parameters, such as Sag, horizontal distance of conductor attachment point from center of tower, swing angle etc. have been taken same as were adopted in the *Guidelines for payment of compensation in regard to Right of Way (RoW) for transmission lines in urban areas* issued by MoP.

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4. Representative from GETCO inquired about effect of “importance factor” for cyclonic region i.e. K4 factor, on the RoW width calculation. In response, representative from M/s Sterlite stated that in the calculation of RoW in table 1 has been done keeping the swing angle constant, there will be no effect of the wind on RoW width.
5. Representative from M/s. Bajel Projects Limited highlighted that the width of cage portion (i.e. Tower width at the cross arm level) of the monopole structures is lower in comparison to lattice tower structures. In view of above, the horizontal distance of conductors can be reduced while maintaining all the clearances requirements and clearance angles. The RoW width for monopole towers can be reduced in comparison to lattice structures, with the smaller horizontal phase to phase distances. In response, CE (PSETD) stated that the minimum horizontal clearances shall be as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023. A separate RoW calculation for the monopole structures can be done to take advantage of reduced tower width in comparison to lattice structures while maintaining the safety clearance requirements as per the regulations. Regarding the minimum horizontal distance between the phases, the values specified in the IS codes is to be followed.
6. Representative from M/s PTCUIL highlighted the following points:
  - a. Instead of keeping different design spans for Normal route/urban or populated area/ forest areas is not preferred and suggested having a single design span for particular voltage levels.
  - b. Only one or two type of configurations shall be adopted for calculation of RoW for particular voltage level.
  - c. RoW for various types of insulator string may not be mentioned separately.
7. In response, representative from CEA stated that the length of the design span was already deliberated and considered in the committee constituted by Ministry of Power 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”, and subsequently, it has been incorporated in Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations.
8. Representative from M/s Adani inquired about methodology to ensure adoption and implementation of recommendations of this committee with State administration, Forest departments and other concerned authorities. He also highlighted that the RoW width calculation associated with one side stringing on tower has not been addressed in the RoW calculations done by the committee.
9. Representative from CEA stated that after finalization of RoW widths, the same will be incorporated in Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, and the same will be communicated to stakeholders and published on CEA website. He further requested the committee to incorporate RoW width calculations for one side stringing on tower.
10. Chief Engineer, PSETD requested all the utilities to come up with RoW width calculations after combining “V and ICA” string type insulators and to tabulate RoW width calculations

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for narrow base towers/mono pole, twin pole structures, etc. with assistance of M/s Volmont Structures Limited and M/s. Bajel Projects Limited. He also suggested that the RoW width calculations may be circulated among the committee members for examination/comments, before convening the next committee meeting.

11. Based on the deliberations held in the meeting following points were concluded:
- a. There will be a separate RoW calculations for lattice type structures and a separate RoW width with other technical solutions i.e. Monopole, Inverted cross arm, twin monopole structures etc. will be kept separately.
  - b. Swings of suspension Insulator and conductor may be fixed as 35 degrees irrespective of voltage level/Span/Wind Zone to have uniformity in calculation of RoW.
  - c. RoW width calculations for "V string and Insulated Cross Arm type insulators may be clubbed together whereas RoW width calculations for "I" string insulators may be done separately. RoW widths with tension insulator strings may not be calculated separately.
  - d. The RoW width calculated shall be valid for plain area i.e. upto altitude 1000 m height above sea level.
  - e. For easier adoption by the stakeholders, after finalization of RoW widths, the same will be incorporated in Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, and the same will be communicated to stakeholders and published on CEA website.
  - f. The RoW width calculations, the CEA regulations and relevant codes are to be complied with.
  - g. Regarding HTLS conductors, committee members will provide inputs whether separate RoW in respect of individual conductor type is to be adopted for various voltage levels or RoW with two or three conventional type conductor for specific voltage level is to be adopted.
  - h. Committee members, in association with the Pole manufacturers, will come up with RoW width calculations after combining "V and ICA" string type insulators, transmission lines with single side stringing, narrow base towers, mono pole, twin pole structures, etc. The inputs received will be circulated to other members of committee for examination before the next meeting.

Meeting ended with thanks to Chair.

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Annexure-I

**List of Participants:****CEA**

1. Shri Ramesh Kumar, Chief Engineer, PSETD Division
2. Shri Bhanwar Singh Meena, Director, PSETD Division
3. Shri Rajesh Kumar Tiwari, Deputy Director CEI Division
3. Shri Mohit Mudgal, Deputy Director, PSETD Division
4. Shri Nishant Chohla, Assistant Director, PSETD division

**POWERGRID**

1. Shri Nitesh Kumar Sinha, Sr.DGM (Engg-TL),

**GETCO**

1. Shri. A. J. Chavda, Chief Engineer
2. Shri. Rathod, Chief Engineer, Projects

**PTCUL**

1. Shri Lalit Kumar, SE

**KPTCL**

1. Shri Sudhakar Garapati, AEE Technical

**DTL**

1. Shri. Dinesh Singh, AGM (Planning)

**M/s Volmont Structures Limited**

1. Shri Kulshrestha Nirmitt
2. Shri Chetan Tare

**Sterlite Power**

1. Shri Jeetendra Bisht
2. Shri Pawan Pitra
3. Shri Siddharth Chaturvedi
4. Shri Md Sharique Afzal
5. Shri Prasad S

**M/s. Adani Power**

1. Shri Ishwar Kailashnath Dubey
2. Shri. Haresh Kumar Vaghasiya
3. Shri Ritesh Kumar Verma,

**EPTA**

1. Shri Manvendra Deswal

**CTC Global**

1. Shri Bhavik Solanki

**M/s Indigrd**

1. Shri. Arnab Chakraborty

**M/s Renew Power**

7

File No.CEA-PS-14-86/2/2019-PSETD Division

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I/32053/2023

1. Shri. Pankaj Kumar Chauhan
2. Shri Anuj Jain
3. Shri Rajat Tiwari

**M/s. Tokyo Rope international Inc**

1. Shri. Jaydeep Ganguly

**M/s SEL Energy**

1. Shri. Krishnajith M U
2. Shri Neeraj Kumar Verma

**M/s Secura**

1. Shri. Neeraj Verma,

## Appendix-III

'34256/2024

File No.CEA-PS-14-86/2/2019-PSETD Division

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भारत सरकार/Government of India  
 विद्युत मंत्रालय/Ministry of Power  
 केन्द्रीय विद्युत प्राधिकरण/Central Electricity Authority  
 विद्युत प्रणाली अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग  
 Power System Engineering & Technology Development Division

Date: 05.03.2024

सेवा में,

&lt;as per addresses &gt;

**विषय:** Minutes of 3<sup>rd</sup> e-meeting of Committee for calculation of reduction of Right-Of-Way (ROW) width through technological options – Reg.

The 3rd e-meeting of the committee constituted under the chairmanship of Chief Engineer (PSETD), CEA was held on 01.03.2024 at 11:00 AM through video conferencing to deliberate on the matter for calculation of reduction of Right-Of-Way (RoW) width through available technological options. The minutes of the meeting are attached for information and necessary action.

संलग्न : उपरोक्त

भवदीय,

(भंवर सिंह मीना /Bhanwar Singh Meena)

निदेशक/Director

Copy to:

- (I) PS to Chairperson, CEA
- (II) PS to Member (Power System), CEA
- (III) CE, PSPA-I, CEA
- (IV) CE, PSPA-II, CEA

## File No.CEA-PS-14-86/2/2019-PSETD Division

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'34256/2024

Addresses:

S No	Name	Address	Email
1.	Managing Director	KPTCL	cmd@powergrid.in
2.	Director (Operations)	MSETCL	dirop@mahatransco.in
3.	Managing Director	PTCUL	md@ptcul.org
4.	Director General,	EPTA	Dg.epta@epta.in epta.dg@gmail.com
5.	Chief Engineer	CEI, CEA	cea-eidivision@gov.in rishika@nic.in
6.	Chief Engineer	PCD, CEA	cepcd.cea@gov.in
7.	Shri K. H. Rathod, I/ C CE (Project)	GETCO	aceproject.getco@gebmil.com md.getco@gebmil.com
8.	Shri N Kumar Sinha, Sr.DGM (Engg-TL),	Powergrid	nksinha@powergrid.in cmd@powergrid.in
9.	Shri Mayank Jaggi	CTC Global	mjaggi@ctcglobal.com
10.	Shri Jeetendra Bisht	Sterlite	Jeetendra.bisht@sterlite.com
11.	Shri Sudhir Nayak	Indigrid	sudhir.nayak@indigrid.com
12.	Shri Jaydeep Ganguly	Tokyo Rope International Inc	jaydeep.ganguly@tokyorope.jp
13.	Shri Ram Kumar	DTL	dgmplanning.dtl2016@gmail.co m md@dtl.gov.in

'34256/2024

Minutes of 3<sup>rd</sup> e-meeting of the committee constituted under the chairmanship of Chief Engineer (PSETD), CEA was held on 01.03.2024 at 11:00 AM through video conferencing to deliberate on the matter for calculation of reduction of Right-Of-Way (RoW) width through available technological options

List of Participants is attached as Annexure-I

1. At the outset Chief Engineer (PSETD), CEA welcomed all the participant and briefed that RoW width calculation table prepared by the committee members was circulated for examinations/comments. He further requested members present during the meeting to provide their suggestions/comments on the calculations.
2. Representative from M/s Sterlite highlighted following points
  - Using High Temperature Low Sag (HTLS) conductor in comparison to conventional conductor at operating temperature of 85°C will reduce the RoW width due to low sag.
  - Calculation of RoW has been done only for Aluminium Alloy Carbon Composite Core (ACCC) conductor out of other types of HTLS conductors available.
3. Representative from M/s Powergrid highlighted following points:
  - RoW may be specified as per voltage level for one type of conductor i.e. conventional conductor rather than defining it for specific conductors.
  - As the width of lattice tower structures is more in comparison to Pole structures, RoW width for lattice towers may be indicated separately, and RoW width requirement for Monopole, Inverted cross arm, twin monopole structures etc. may be clubbed together to remove ambiguity.
  - Few manufacturers are making ACCC and presently there is single supplier of the core for these ACCC conductor which does not provide level playing field.
  - He also highlighted earth wire to live metal clearance must be maintained at different temperature.
4. Representative from M/s CTC Global highlighted that ACCC conductor has lower sag which will reduce the Right of Way (RoW) width and the areas where RoW issues are being faced can be addressed.
5. Director (PSTED) stated that RoW for HTLS should be calculated for maximum operating temperature and 35 degree swing angle because in order to enhance the power transmission capacity on existing lines with HTLS conductors in the future, it's possible that the operating temperature may need to be raised. However, this increase in temperature could lead to greater conductor sag, necessitating adjustments to the RoW.
6. Representatives from M/s Valmont Structures Limited stated that they could not get sufficient data for calculating the RoW width for Monopole/Twin Pole.
7. CE (PSETD) highlighted that RoW calculations could involve factors like voltage levels, tower types, conductor types, and string types (such as I string and ICA/V string), along with terrain category. Considering the extensive data involved, he suggested that making certain assumptions might be necessary to simplify and organize the information more effectively.  
He stated that M/s Sterlite may come up with RoW calculations for Lattice type structure for various types of HLTS conductors at their highest operating temperature so that it can



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be compared if there is any saving in RoW. He requested M/s Powergrid to carryout RoW calculations for Monopole, Inverted cross arm and Twin Pole structure, etc for ACSR conductor. He further added that the calculation table should be provided at the earliest, so that it can be circulated among members before next meeting.

Meeting ended with thanks to Chair.

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'34256/2024

## Annexure-I

**List of Participants:****CEA**

- Shri Ramesh Kumar, Chief Engineer, PSETD Division
- Mrs. Rishika Sharan, Chief Engineer, CEI Division
- Shri Bhanwar Singh Meena, Director, PSETD Division
- Shri Alok Kumar, Deputy Director CEI Division
- Shri Amrendra Pratap Singh, Assistant Director, PSETD division
- Shri Nishant Chohla, Assistant Director, PSETD division

**POWERGRID**

- Shri Nitesh Kumar Sinha, Sr.DGM (Engg-TL),

**PTCUL**

- Shri Lalit Kumar, SE

**KPTCL**

- 1. Shri Sudhakar Garapati, AEE Technical

**M/s Volmont Structures Limited**

- Shri Kulshrestha Nimit
- Shri Chetan Tare

**Sterlite Power**

- Shri Pawan Pitra, AVP, Sterlite Power
- Shri Md Sharique Afzal, Sterlite Power
- Shri Prasad S
- Shri Ananthakumar

**M/s. Adani Power**

- Shri Ishwar Kailashnath Dubey, Adani
- Shri. Haresh Kumar Vaghasiya, Projects
- Shri Ritesh Kumar Verma, Survey

**EPTA**

- Shri Manvendra Deswal, EPTA

**CTC Global**

- Shri Bhavik Solanki
- Shri. Hitesh Mundhada

**M/s Indigrid**

- 1. Shri. Sudhir Nayak

**M/s Renew Power**

- 1. Shri Rajat Tiwari

CEA-PS-14-86/2/2019-PSETD Division

## Appendix-IV

I/40373/2024



**भारत सरकार/Government of India**  
**विद्युत मंत्रालय/Ministry of Power**  
**केन्द्रीय विद्युत प्राधिकरण/Central Electricity Authority**  
**विद्युत प्रणाली अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग**  
**Power System Engineering & Technology Development**  
**Division**

Date: 27.05.2024

सेवा में,

&lt;As per addresses &gt;

**विषय: Minutes of 4<sup>th</sup> e-meeting of Committee for calculation of reduction of Right-Of-Way (ROW) width through technological options – Reg.**

The 4<sup>th</sup> e-meeting of the committee constituted under the chairmanship of Chief Engineer (PSETD), CEA was held on 15.05.2024 at 03:00 PM through video conferencing to deliberate on the matter for calculation of reduction of Right-Of-Way (ROW) width through available technological options. In this meeting, the following two references were also discussed:

- (i). M/s Powergrid reference on transmission line ground clearance requirement for free movement of Harvester and other agriculture equipment.
- (ii). Right of Way (ROW) for 33 and 66 kV lines – Diversion of Forest Land issues of small hydro projects

The minutes of the meeting are attached at Annexure.

संलग्न : उपरोक्त

भवदीय,

(भंवर सिंह मीना /Bhanwar Singh Meena)

निदेशक/Director

Copy to:

- (I) CE, PSPA-I, CEA
- (II) CE, PSPA-II, CEA
- (III) SA to Chairperson, CEA
- (IV) SA to Member (Power System), CEA

CEA-PS-14-86/2/2019-PSETD Division

I/40373/2024

**Addresses:**

S No	Name	Address	Email
1.	Managing Director	KPTCL	<a href="mailto:md@kptcl.com">md@kptcl.com</a>
2.	Director (Operations)	MSETCL	<a href="mailto:dirop@mahatransco.in">dirop@mahatransco.in</a>
3.	Managing Director	PTCUL	<a href="mailto:md@ptcul.org">md@ptcul.org</a>
4.	Director General,	EPTA	<a href="mailto:Dg.epta@epta.in">Dg.epta@epta.in</a> <a href="mailto:epta.dg@gmail.com">epta.dg@gmail.com</a>
5.	Chief Engineer	CEI, CEA	<a href="mailto:cea-eidivision@gov.in">cea-eidivision@gov.in</a> <a href="mailto:rishika@nic.in">rishika@nic.in</a>
6.	Chief Engineer	PCD, CEA	<a href="mailto:cepcd.cea@gov.in">cepcd.cea@gov.in</a>
7.	Shri K. H. Rathod, I/ C CE (Project)	GETCO	<a href="mailto:aceproject.getco@gebmail.com">aceproject.getco@gebmail.com</a> <a href="mailto:md.getco@gebmail.com">md.getco@gebmail.com</a>
8.	Shri N Kumar Sinha, Sr.DGM (Engg-TL),	Powergrid	<a href="mailto:nksinha@powergrid.in">nksinha@powergrid.in</a> <a href="mailto:cmd@powergrid.in">cmd@powergrid.in</a>
9.	Shri Mayank Jaggi	CTC Global	<a href="mailto:mjaggi@ctcglobal.com">mjaggi@ctcglobal.com</a>
10.	Shri Jeetendra Bisht	Sterlite	<a href="mailto:Jeetendra.bisht@sterlite.com">Jeetendra.bisht@sterlite.com</a>
11.	Shri Sudhir Nayak	Indigrid	<a href="mailto:sudhir.nayak@indigrid.com">sudhir.nayak@indigrid.com</a>
12.	Shri Jaydeep Ganguly	Tokyo Rope International Inc	<a href="mailto:jaydeep.ganguly@tokyorope.jp">jaydeep.ganguly@tokyorope.jp</a>
13.	Shri Ram Kumar	DTL	<a href="mailto:dgmplanning.dtl2016@gmail.com">dgmplanning.dtl2016@gmail.com</a> <a href="mailto:md@dtl.gov.in">md@dtl.gov.in</a>

## Annexure

**Minutes of 4<sup>th</sup> e-meeting of the committee constituted under the chairmanship of Chief Engineer (PSETD), CEA was held on 15.05.2024 at 03:00 PM through video conferencing to deliberate on the matter for calculation of reduction of Right-Of-Way (ROW) width through available technological options**

At the outset Chief Engineer (PSETD), CEA welcomed all the participant. The list of Participants is attached as Annexure-I. It was stated that a committee was constituted vide letter dated 25.07.2023 with the following terms of reference:

- (i). Calculation of RoW in case of Insulated Cross Arm Insulators
- (ii). Calculation of RoW in case of Monopole Towers.
- (iii). Calculation of RoW in case of HTLS Conductors.

It was further stated that three committee meetings were held on 22.08.2023, 31.10.2023, and 01.03.2024. Director (PSE&TD), CEA was requested to provide a summary of these meetings and discuss the agenda for this meeting.

2. Director (PSE&TD), CEA gave a brief presentation on the deliberations held during previous meetings and stated that this meeting has been called to discuss the calculations of ROW width in respect of pole structures provided by M/s Powergrid and calculations of ROW width in respect of lattice structures provided by M/s Sterlite. Director (PSE&TD), CEA requested M/s Powergrid and M/s Sterlite to explain calculations done by them.
3. The representative of M/s Powergrid stated that the calculations has been done as per voltage level, tower configuration, conductor type, terrain category and design spans as per CEA's "Standard Technical Specification for Steel Monopole Structure for AC Transmission Line". The representative further stated that the Insulated Cross Arm (ICA) drop has been taken same as that of M/s Sterlite ROW width calculations being done for the lattice type structures.
4. Director (PSE&TD), CEA enquired about the calculations of ROW width for tension type string as the same has not been provided for pole structures. In reply of this, the representative of M/s Powergrid stated that the calculations of ROW width for tension string has not been done. Director (PSE&TD), CEA requested M/s Powergrid to provide the ROW calculations for tension string.
5. The representative of M/s Powergrid also stated that Powergrid does not have experience of using 'V' string on the pole structures at 220 kV and 132 kV voltage levels, therefore, the calculations of ROW width have not been done for V string at these voltage level. It was also stated that Powergrid has not designed pole structure for 765 kV D/C due to limitations in manufacturing process, therefore, the ROW width has only been calculated for 765 kV S/C.
6. Director (PSE&TD), CEA enquired all the utilities whether they agrees with the calculations submitted by M/s Powergrid for pole structures. In response of this, all utilities agreed to the same.

7. Director (PSE&TD), CEA requested M/s Sterlite to present their calculations of ROW width done for the lattice type structures.
8. M/s Sterlite stated that they have calculated ROW width calculation for various HTLS conductors and ACSR conductors. The calculation of ROW width for various HTLS conductors has been done at 85 deg. Celsius and at their maximum continuous operating temperature in deg. Celsius.
9. In response to the query raised by CE (PSE&TD), CEA about the maximum continuous operating temperature in Deg. Celsius for HTLS conductors, the representative of M/s Sterlite stated that the maximum continuous operating temperature is different for different type of HTLS conductors. The representative of M/s Sterlite further stated that the ROW width calculated at maximum operating temperature for ACCC conductor shows reduction in ROW width whereas for the GAP, ACSS and other HTLS conductors there is no reduction in ROW width as compare to ROW width given in Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022.
10. The representative of M/s Powergrid stated that the electrical parameter i.e., the electric field at edge of ROW (kV/m) also need to be checked while calculating ROW width. In response of this, the representative of M/s Sterlite stated that in present calculations the cited parameter has not been considered. M/s Sterlite agreed for incorporating the parameter i.e., the electric (kV/m) at lowest point of conductor and at the edge of ROW in the ROW width calculations.
11. Director (PSE&TD), CEA requested M/s Sterlite to come up with ROW width calculations at highest operating temperature for all types of HTLS conductors including the parameter, i.e., the electric field (in kV/m) at lowest point of conductor and at edge of ROW.
12. The representative of M/s Sterlite submitted that the present calculations of ROW is indicative and the detailed calculations of ROW will be submitted after incorporating all the parameters along with the combinations like terrain category, circuit type, voltage level, design span, etc.
13. The representative of KPTCL submitted that the calculations of ROW width for D/C single side cross arm for monopole structures at 110 kV and 220 kV voltage levels has also been done at their end. CE (PSE&TD), CEA requested KPTCL to submit the calculations of ROW width for D/C single side cross arm for monopole structures at 110 kV and 220 kV voltage levels. Further, the representative of KPTCL stated that KPTCL have designed a 110 kV D/C narrow base tower with increased bottom cross arm height for laying of transmission lines through forest areas to avoid tree cutting. In respect of proposal of KPTCL, M/s Sterlite stated that the proposal of KPTCL is not cost effective and needs to be further deliberated.

CE (PSE&TD), CEA stated that during stringing of conductor completely avoiding tree cutting is not possible. Director (PSE&TD), CEA also stated that by raising the height of tower, ROW will not get reduced. In response, the representative of KPTCL stated that

after laying of transmission lines, maintenance of the transmission line would be easy. KPTCL was requested to submit the proposal among committee members, so that same can be discussed in next committee meeting.

14. Director (PSE&TD), CEA pointed out that minimum mid span clearances between earth wire and HTLS conductor need to be maintained as per safety requirement and a study needs to be carried out by the TSPs considering temperature coefficient of expansion for OPGW wire and HTLS conductor for re-conductoring as well as new lines.
15. Based on the deliberations held in the meeting in respect of calculation of reduction of Right-Of-Way (ROW) width through available technological options, the following points were concluded:
  - (i). M/s Powergrid to provide the ROW width calculations using tension string for pole structures. The electric field at lowest point of conductor and at edge of RoW (kV/m) indicating the limits of electric field to be provided for all combinations of RoW.
  - (ii). M/s Sterlite to provide calculations of ROW width at the highest operating temperature for all types of HTLS conductors and the parameter i.e., the electric field at lowest point of conductor and at edge of ROW (kV/m) indicating the limits of electric field. The combinations like terrain category, circuit type, voltage level, design span, conductor type (indicating maximum operating temperature for different types of HTLS conductors), etc. shall also be included in ROW width calculations.
  - (iii). M/s Sterlite to provide calculations of mid span clearance between earth wire/OPGW and HTLS conductors in case of up gradation of existing transmission lines as well as for new transmission lines.
  - (iv). KPTCL to submit the calculations of ROW width for D/C single side cross arm for monopole structures at 110 kV and 220 kV voltage levels.
  - (v). All the committee members, representative of utilities present in the meeting were requested to review the calculation to be submitted by M/s Powergrid and M/s Sterlite and to provide the justification in case they do not agree with the calculations within 15 days.
  - (vi). The Committee members were requested to provide their views on KPTCL's proposal of designing 110 kV D/C narrow base tower with increased bottom cross arm height for laying of transmission lines through forest areas to avoid tree cutting.
16. Director (PSE&TD), CEA stated that two more agenda are to be discussed in the meeting:
  - (i). M/s Powergrid's reference on transmission line ground clearance requirement for free movement of Harvester and other agriculture equipment.
    - (a) The representative of M/s Powergrid stated that at the voltage levels 132 kV and 220 kV they are facing ground clearance issue in agricultural area due to movement of Harvester and other heavy agricultural equipment. It was further stated that transmission lines generally passes through agricultural areas and it would be difficult to identify the lines which are passing through the areas where harvester or other agricultural equipment are being used.
    - (b) Director (PSE&TD), CEA requested M/s Powergrid to take up the issue with the concerned authority who standardize the height of harvester equipment, it was further requested to provide the detail of region where the issue of transmission line ground clearance requirement for free movement of harvester is being faced.

- (c) The Committee members were requested to provide their comments on the issue raised by M/s Powergrid.
- (ii) Right of Way (RoW) for 33 and 66 kV lines – Diversion of Forest land issues of small hydro projects in hilly/valley areas.
- (a) Director (PSE&TD), CEA requested M/s Powergrid to provide their comments on the issue raised by Federation of Indian Small Hydropower (FISH). In response of this, the representative of M/s Powergrid stated that the stated type of issue in Powergrid is dealt with Distribution Management Services (DMS) and the issue will be forwarded to DMS for comments on the same.
17. CE (PSE&TD). CEA requested all the committee members to provide their comments on all the issues deliberated on urgent basis.

Meeting ended with thanks to Chair.

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## Annexure-I

**List of Participants:****CEA**

- Shri A K Rajput, Member (PS), CEA
- Shri Chandra Praksah, Chief Engineer, PSETD Division
- Shri Bhanwar Singh Meena, Director, PSETD Division
- Smt. Kanchan Chauhan, Deputy Director, PSPA-1 Division
- Shri Alok Kumar, Deputy Director CEI Division
- Shri Rahul Singh, Deputy Director CEI Division
- Shri Gaurav Srivastava, Assistant Director, PSETD division
- Shri Nishant Chohla, Assistant Director, PSETD division
- Shri Amrendra Pratap Singh, Assistant Director, PSETD division

**POWERGRID**

- Shri Nitesh Kumar Sinha, Sr.DGM (Engg-TL),

**PTCUL**

- Shri Lalit Kumar, SE

**GETCO**

- Shri. A J Soni

**KPTCL**

- Shri Sudhakar Garapati, AEE Technical

**Sterlite Power**

- Shri Pawan Pitra, AVP, Sterlite Power
- Shri Prasad S

**CTC Global**

- Shri Bhavik Solanki

CEA-PS-14-86/2/2019-PSETD Division

Appendix-V

I/43181/2024



**भारत सरकार/Government of India**  
**विद्युत मंत्रालय/Ministry of Power**  
**केन्द्रीय विद्युत प्राधिकरण/Central Electricity Authority**  
**विद्युत प्रणाली अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग**  
**Power System Engineering & Technology Development**  
**Division**

Date: 20.09.2024

सेवा में,

&lt;As per addresses &gt;

**विषय:** Minutes of 5<sup>th</sup> e-meeting of Committee for calculation of reduction of Right-Of-Way (ROW) width through technological options – Reg.

The 5<sup>th</sup> e-meeting of the committee constituted under the chairmanship of Chief Engineer (PSETD), CEA was held on 13.09.2024 at 03:00 PM through video conferencing to deliberate on the matter for calculation of reduction of Right-Of-Way (ROW) width through available technological options.

The minutes of the meeting are attached at **Annexure**.

संलग्न : उपरोक्त

भवदीय,

(भंवर सिंह मीना /Bhanwar Singh Meena)

निदेशक/Director

Copy to:

- (I) CE, PSPA-I, CEA
- (II) CE, PSPA-II, CEA
- (III) SA to Chairperson, CEA
- (IV) SA to Member (Power System), CEA

CEA-PS-14-86/2/2019-PSETD Division

I/43181/2024

**Addresses:**

S No	Name	Address	Email
1.	Managing Director	KPTCL	<a href="mailto:md@kptcl.com">md@kptcl.com</a>
2.	Director (Operations)	MSETCL	<a href="mailto:dirop@mahatransco.in">dirop@mahatransco.in</a>
3.	Managing Director	PTCUL	<a href="mailto:md@ptcul.org">md@ptcul.org</a>
4.	Director General,	EPTA	<a href="mailto:Dg.epta@epta.in">Dg.epta@epta.in</a> <a href="mailto:epta.dg@gmail.com">epta.dg@gmail.com</a>
5.	Chief Engineer	CEI, CEA	<a href="mailto:cea-eidivision@gov.in">cea-eidivision@gov.in</a> <a href="mailto:rishika@nic.in">rishika@nic.in</a>
6.	Chief Engineer	PCD, CEA	<a href="mailto:cepcd.cea@gov.in">cepcd.cea@gov.in</a>
7.	Shri K. H. Rathod, I/C CE (Project)	GETCO	<a href="mailto:aceproject.getco@gebmail.com">aceproject.getco@gebmail.com</a> <a href="mailto:md.getco@gebmail.com">md.getco@gebmail.com</a>
8.	Shri N Kumar Sinha, Sr.DGM (Engg-TL),	POWERGRID	<a href="mailto:nksinha@POWERGRID.in">nksinha@POWERGRID.in</a> <a href="mailto:cmd@POWERGRID.in">cmd@POWERGRID.in</a>
9.	Shri Mayank Jaggi	CTC Global	<a href="mailto:mjaggi@ctcglobal.com">mjaggi@ctcglobal.com</a>
10.	Shri Jeetendra Bisht	Sterlite	<a href="mailto:Jeetendra.bisht@apar.com">Jeetendra.bisht@apar.com</a>
11.	Shri Sudhir Nayak	Indigrid	<a href="mailto:sudhir.nayak@indigrid.com">sudhir.nayak@indigrid.com</a>
12.	Shri Jaydeep Ganguly	Tokyo Rope International Inc	<a href="mailto:jaydeep.ganguly@tokyorope.jp">jaydeep.ganguly@tokyorope.jp</a>
13.	Shri Ram Kumar	DTL	<a href="mailto:dgmplanning.dtl2016@gmail.com">dgmplanning.dtl2016@gmail.com</a> <a href="mailto:md@dtl.gov.in">md@dtl.gov.in</a>

**Annexure**

**Minutes of 5<sup>th</sup> e-meeting of the committee constituted under the chairmanship of Chief Engineer (PSETD), CEA was held on 13.09.2024 at 03:00 PM through video conferencing to deliberate on the matter for calculation of reduction of Right-Of-Way (ROW) width through available technological options**

The list of the Participants is attached as Annexure-I.

The 5th meeting of the Committee was held on 13.09.2024. Earlier four committee meetings were held on 22.08.2023, 31.10.2023, 01.03.2024 and 15.05.2024.

1. CE (PSETD), CEA informed that Right of Way (RoW) width have been tabulated with combinations of conductor and lattice tower/monopole based on the data received from POWERGRID and M/s Sterlite. The RoW tables were circulated to all the committee members before convening this meeting and committee members were requested to present their views on RoW tables.
2. CE (PSETD) enquired about the basis of phase-phase spacing in the submitted inputs of pole structures by POWERGRID, and whether the effects of electric and magnetic fields, maintenance of one circuit while the other circuit is in live condition were considered while calculating the same. In reply of this, POWERGRID stated that the horizontal distance from the center of the pole to the conductor attachment point i.e half the horizontal phase to phase spacing has been calculated considering swing, string length, required clearances, and diameter of the pole. CE (PSETD), CEA further highlighted that Phase to Phase spacing at 132 kV voltage level has been indicated greater than phase to phase spacing at 220 kV level which appears to be incorrect. In reply of this, POWERGRID stated that inputs on the query will be provided shortly.
3. Committee deliberated on the required parameters for tower/pole with Insulated Cross Arm (ICA). It was agreed that since ICA is not currently being used in transmission towers in India and requisite inputs are not available, the Right of Way (RoW) width for ICA may not be considered at this stage. However, a note will be included in the report for calculation of the RoW width for ICA in the future.
4. CE (PSETD) stated that RoW width for HTLS conductor with Pole structure has been calculated based on the inputs received from M/s Sterlite. It was highlighted that M/s Sterlite has submitted the sag values of Carbon Fiber Composite Core (CFCC), Aluminum Conductor Steel Supported (ACSS) and Gap-type Aluminum Conductor Steel Reinforced (GZTACSR) at 180 °C, 250 °C and 210 °C respectively.
5. The representative of POWERGRID highlighted the issue of low sag of HTLS conductors as compared to conventional conductor and raised concern about correctness of sag data. In reply of this, M/s Sterlite stated that HTLS has better sag property. M/s Sterlite was requested to provide input PLSCAD files for sag calculations to the POWERGRID so that the same may be verified by POWERGRID. M/s Sterlite was further requested to provide sag calculation for ACSR Bersimis equivalent HTLS conductor for 765 kV line.
6. Upon enquiry on use of pole structure at 66 kV level in the state of Karnataka, KPTCL replied that pole structure with ACSR conductor is being used in Karnataka. CE(PSETD)

requested KPTCL to provide the input data of Phase to Phase spacing (I/V/Tension string) of pole structure, sag of conductor used at different span, electric field at the edge of RoW and at the bottom most conductor of transmission line, etc. which are required to calculate the RoW width. KPTCL agreed to provide the data.

7. Director (PSETD), CEA informed that as discussed in the previous meetings, the electric field below the lowest point of conductor and at edge of RoW (kV/m) to be provided for all combinations of RoW are awaited from M/s Sterlite and POWERGRID.
8. Based on the deliberations held in the meeting in respect of calculation of reduction of Right-Of-Way (ROW) width through available technological options, the following points were concluded:
  - (i) Single circuit transmission lines shall not be used up to 400 kV voltage level. Therefore, Committee decided that RoW width shall not be specify for the Single Circuit tower up to 400 kV voltage level.
  - (ii) M/s Sterlite to provide input PLSCAD files for sag calculations to the POWERGRID.
  - (iii) POWERGRID to review the sag calculation submitted by M/s Sterlite and provide data regarding phase to phase spacing for 132 kV line.
  - (iv) POWERGRID and M/s Sterlite to provide input in respect of electric & magnetic fields.
  - (v) KPTCL to provide the relevant data to calculate the RoW width for pole structures used in Kamataka.
  - (vi) M/s Sterlite to provide sag calculation for ACSR Bersimis equivalent HTLS conductor for 765 kV line
  - (vii) The utility representatives present at the meeting were requested to provide their inputs and comments on the Right of Way (RoW) table, ensuring that the required phase-to-phase spacing, safety electrical clearances, and limits for electric and magnetic fields comply with the relevant standards and CEA regulations.

Meeting ended with thanks to Chair.

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**To:**

CMD, Powergrid Corporation of India Ltd., Saudamini, Plot No. 2, Sector-29, Gurgaon- 122001 (Haryana). E-mail: <a href="mailto:cmd@powergrid.in">cmd@powergrid.in</a>	Director General, Central Power Research Institute, P B No.8066, Sadashivnagar PO, Prof. Sir C V Raman Road, Bangalore - 560 080 <a href="mailto:dgcpri@cpri.in">dgcpri@cpri.in</a> , <a href="mailto:mchandra@cpri.in">mchandra@cpri.in</a>
Managing Director Karnataka Power Transmission Corporation Ltd., 1st floor, Kaveri Bhawan, K. G. Road, Bangalore-560009 Ph.:080-22214342 Email: <a href="mailto:md@kptcl.com">md@kptcl.com</a>	Director (Operations), Maharashtra State Electricity Transmission Company Ltd., C- 19, E- Block Prakashganga, Bandra-Kurla Complex Bandra(E), Mumbai 400 051. Ph.: 022-26476909 E- mail: <a href="mailto:dirop@mahatransco.in">dirop@mahatransco.in</a>
Managing Director Gujarat Energy Transmission Corporation Limited (GETCO), Sardar Patel Vidyut Bhavan, Race Course, Vadodara-390007. Gujarat (INDIA) E- mail: <a href="mailto:md.getco@gebmail.com">md.getco@gebmail.com</a>	Member-Secretary Southern Regional Power Committee No. 29, Race Course Cross Road, Bengaluru- 560009 <a href="mailto:mssrpc-ka@nic.in">mssrpc-ka@nic.in</a>
Managing Director Power Transmission Corporation of Uttarakhand Limited VidyutBhawan, Near ISBT Crossing, Saharanpur Road, Majra, Dehradun-248002 Email: <a href="mailto:md@ptcul.org">md@ptcul.org</a>	Managing Director, Delhi Transco Ltd, Shakti Sadan, Kotla Marg, New Delhi- 110002 Email: <a href="mailto:md@dtl.gov.in">md@dtl.gov.in</a>
Director General, EPTA Email: <a href="mailto:Dg.epta@epta.in">Dg.epta@epta.in</a> ; <a href="mailto:epta.dg@gmail.com">epta.dg@gmail.com</a>	Regional Manager-Business Development, CTC Global. E-mail: <a href="mailto:mjaggi@ctcglobal.com">mjaggi@ctcglobal.com</a>
Member-Secretary, Western Regional Power Committee F-3, MIDC Area, Marol, Opposite SEEPZ, Central Road, Andheri (East), Mumbai-400093 <a href="mailto:ms-wrpc@nic.in">ms-wrpc@nic.in</a> ,	Member-Secretary Eastern Regional Power Committee 14, Golf Club Rd, Golf Gardens, Tollygunge, Kolkata, West Bengal- 700033 <a href="mailto:mserpc-power@nic.in">mserpc-power@nic.in</a> ,
Member-Secretary Northern Regional Power Committee, 18-A, Qutab Institutional Area, Shaheed Jeet Singh Marg, Katwaria Sarai, New Delhi110016 <a href="mailto:ms-nrpc@nic.in">ms-nrpc@nic.in</a> ,	Member Secretary, North Eastern Regional Power Committee, NERPC Complex, Dong Parmaw, Lapalang, Shillong – 793006 (Meghalaya). <a href="mailto:nerpc@ymail.com">nerpc@ymail.com</a>
Director, Structural Engineering Research Centre, CSIR Campus, Taramani, Post Box No.8287, Chennai–600 113 (Fax No.044-22641734) <a href="mailto:director@serc.res.in">director@serc.res.in</a>	Head of the Department, Civil Engg., Delhi Technological University, Shahbad Daulatpur, Bawana Road, Delhi- 110 042 (Fax No.011-27852188) <a href="mailto:sksinghdce@gmail.com">sksinghdce@gmail.com</a>
Mr. Bipin B. Shah, Vice President–Transmission, Torrent Power	Shri E.V. Rao, KEC International Limited, RPG House,

Limited, 3rd Floor, Jubilee 2. House, Shahpur, Ahmedabad-380001 <a href="mailto:bipinbshah@torrentpower.com">bipinbshah@torrentpower.com</a>	463, Dr. Annie Besant Road, Worli, Mumbai-4000 03 <a href="mailto:raoiev@kecrpg.com">raoiev@kecrpg.com</a>
Chairman Sterlite Power The Mira Corporate, Suit, Plot No. 1&2, C Block, 2nd Floor, Ishwar Nagar, Mathura Road, New Delhi – 110065 <a href="mailto:rohit.gera@sterlite.com">rohit.gera@sterlite.com</a> <a href="mailto:tan.reddy@sterlite.com">tan.reddy@sterlite.com</a>	Shri Kaushal Thakkar, Manager, Kalpataru Power Transmission Ltd., Plot No. 101, Part III, GIDC Estate, Sector 28, Gandhinagar-382028, Gujarat <a href="mailto:kaushal.thakkar@kalpatarupower.com">kaushal.thakkar@kalpatarupower.com</a>
Shri P.G. Suresh Kumar, Director, L&T IDPL, Kudgi Transmission Ltd., 1 st Floor, TCTC Building, Mount Poonamallee Road, Manapakkam, Chennai- 600 089 <a href="mailto:pgsk@Lntidpl.com">pgsk@Lntidpl.com</a>	Chairman & Managing Director, Rajasthan Rajya Vidyut Prasaran Nigam Ltd. Vidyut Bhawan, Janpath, Jyoti Nagar, Jaipur (Rajasthan) – 302005(0172- 2560815) <a href="mailto:cmd.rvpn@gmail.com">cmd.rvpn@gmail.com</a>
Chairman & Managing Director, Damodar Valley Corp. Head Quarter DVC Towers, VIP Road Kolkata – 700054 <a href="mailto:chairman@dvc.gov.in">chairman@dvc.gov.in</a>	Chairman & Managing Director, Uttar Pradesh Power Transmission Corporation Ltd. Shakti Bhawan, 14-A, Ashok Marg, Lucknow – 226001 <a href="mailto:cmd@upptcl.org">cmd@upptcl.org</a>
Sri Balabanta Basumatary, CGM (PP&D), AEGCL <a href="mailto:cgm.ppd@aegcl.co.in">cgm.ppd@aegcl.co.in</a>	Sr. Vice President, M/s Adani Power Limited, 7th Floor, Sambhav Building, Judges Bungalow Road, Bodakdev, Ahmedabad, Gujarat-380015 <a href="mailto:praveen.tamak@adani.com">praveen.tamak@adani.com</a> <a href="mailto:sameer.ganju@adani.com">sameer.ganju@adani.com</a>
Chairman Bhakra Beas Management Road, Sector -19B, Madhya Marg, Chandigarh – 160019 <a href="mailto:cman@bbmb.nic.in">cman@bbmb.nic.in</a>	Business Development Head, CFCC Cable Division, Tokyo Rope International. E-mail: <a href="mailto:Jaydeep.ganguly@tokyorope.jp">Jaydeep.ganguly@tokyorope.jp</a>
Managing Director, Himachal Pradesh Power Development Corporation Ltd. Barowalia House, Khalini Shimla - 171004 <a href="mailto:md@hppcl.in">md@hppcl.in</a>	Chairman & Managing Director Transmission Corporation of Andhra Pradesh Limited Vidyut Soudha, Gunadala, Eluru Rd, Vijayawada, Andhra Pradesh 520004 <a href="mailto:ce.trans@aptransco.gov.in">ce.trans@aptransco.gov.in</a> , <a href="mailto:surendrababu.karreddula@aptransco.co.in">surendrababu.karreddula@aptransco.co.in</a>
Chairman & Managing Director Orissa Power Transmission Corporation Ltd. Janpath, Bhubaneswar- 751 022. <a href="mailto:cmd@optcl.co.in">cmd@optcl.co.in</a> <a href="mailto:dir.operation@optcl.co.in">dir.operation@optcl.co.in</a> <a href="mailto:ele.bpmohapatra@optcl.co.in">ele.bpmohapatra@optcl.co.in</a> <a href="mailto:ele.ssahu@optcl.co.in">ele.ssahu@optcl.co.in</a>	Director (Operations) Rajasthan Rajya Vidyut Prasaran Nigam Ltd. Vidyut Bhawan, Jyoti Nagar Jaipur (Rajasthan) Ph.: 0141-2740814 <a href="mailto:dir.oper@rvpn.co.in">dir.oper@rvpn.co.in</a> <a href="mailto:cmd.rvpn@gmail.com">cmd.rvpn@gmail.com</a> ,
Chairman & Managing Director	Managing Director

Uttar Pradesh Power Transmission Corporation Ltd. Shakti Bhawan, 14-A, Ashok Marg, Lucknow- 226001 <a href="mailto:cmd@upptcl.org">cmd@upptcl.org</a>	Assam Electricity Grid Corporation Ltd. Bijulee Bhawan, Paltan Bazar Guwahati- 781 001 <a href="mailto:managing.director@aecl.co.in">managing.director@aecl.co.in</a> , <a href="mailto:md_aegcl@yahoo.co.in">md_aegcl@yahoo.co.in</a>
Managing Director Madhya Pradesh Power Transmission Company Ltd. Shakti Bhawan, Rampur, Jabalpur(MP) - 482 008 Ph.: 0761-2661234 <a href="mailto:md@mptransco.nic.in">md@mptransco.nic.in</a> <a href="mailto:gargava.pk@mptransco.nic.in">gargava.pk@mptransco.nic.in</a> ; <a href="mailto:sanjeev.shrivastava65@gmail.com">sanjeev.shrivastava65@gmail.com</a> ;	Managing Director TANTRANSCO 10th Floor/NPKRR Malikai, No. 144 Anna Salai, Chennai-600002 Ph.: 044-28521057 <a href="mailto:mdtantransco@tnebnet.org">mdtantransco@tnebnet.org</a>
Chairman & Managing Director, Punjab State Transmission Corporation Ltd. The Mall, Mall Road, Patiala – 147001, Punjab <a href="mailto:cmd@pstcl.org">cmd@pstcl.org</a>	Chief Engineer (Transmission) Jharkhand Urja Sancharan Nigam Ltd. (JUSNL) Engineering Buliding, HEC, Dhurwa, Ranchi – 834004 <a href="mailto:mdjusnl@gmail.com">mdjusnl@gmail.com</a>
West Bengal State Electricity Transmission Company Ltd (WBSETCL) Vidyut Bhawan, Block-DJ, Sector-II, Bidhan Nagar, Kolkata- 700 091. <a href="mailto:md@wbsetcl.in">md@wbsetcl.in</a>	Chairman & Managing Director Chhattisgarh State Power Holding Company Ltd., Vidyut Seva Bhawan P.O. Sunder Nagar, Danganiya, Raipur- 492 013 (Chhattisgarh) <a href="mailto:mddiscom@gmail.com">mddiscom@gmail.com</a> , <a href="mailto:mddiscom@cspc.co.in">mddiscom@cspc.co.in</a>
Chairman Haryana Vidyut Prasaran Nigam Ltd. Shakti Bhawan, Sector No. 6 Panchkula – 134109, Haryana <a href="mailto:chairman@hvpn.org.in">chairman@hvpn.org.in</a>	Chairman Kerala State Electricity Board Board Secretariat Vidyuthi Bhavanam Pattom Thiruvananthapuram – 695004 <a href="mailto:cmdkseab@kseab.in">cmdkseab@kseab.in</a>
Chairman & Managing Director, Transmission Corporation of Telangana Ltd. Vidyut Soudha, Khairatabad, Hyderabad – 500082 <a href="mailto:cmd@tstransco.in">cmd@tstransco.in</a>	Managing Director, Bihar State Power Transmission Company Ltd. Vidyut Bhawan, Bailey Road Patna – 800021 <a href="mailto:mdcellbsptcl@gmail.com">mdcellbsptcl@gmail.com</a>
Managing Director, Jammu & Kashmir State Power Transmission Corporation Ltd. Exhibition Ground, Jahangir Chowk, Srinagar (J&K) - 190009 <a href="mailto:md@jkspdcl.com">md@jkspdcl.com</a>	Shri N.L. Sharma, Chairman & Managing Director, SJVN Limited, Shakti Sadan, Corporate Office, Complex Shanan, Shimla - 171006 Himachal Pradesh <a href="mailto:nandlal.sharma@sjvn.nic.in">nandlal.sharma@sjvn.nic.in</a>
Chairman & Managing Director,	Chairman & Managing Director



<p>Damodar Valley Corp. Head Quarter DVC Towers, VIP Road Kolkata – 700054 <a href="mailto:chairman@dvc.gov.in">chairman@dvc.gov.in</a></p>	<p>National Hydro Power Corporation Ltd. Corporate Office, NHPC Office Complex, Sector 33, Faridabad- 121003, Haryana <a href="mailto:cmd@nhpc.nic.in">cmd@nhpc.nic.in</a></p>
<p>Chairman &amp; Managing Director Tripura State Elec. Corporation Ltd. Govt. of Tripura, Bidyut Bhawan Agartala- 799 001. <a href="mailto:managing.director@tsecl.in">managing.director@tsecl.in</a> <a href="mailto:director.technical@tsecl.in">director.technical@tsecl.in</a></p>	<p>Shri Milind Nene, Dy. President, Kalpataru Power Transmission Ltd., Plot No. 101, Part-III, GIDC Estate, Sector-28, Gandhinagar-382028, Gujarat milind.nene@kalptarupower.com kaushal.thakkar@kalptarupower.com ajay.tripathi@kalptarupower.com gaurav.sarda@kalptarupower.com Alok.Prasad@kalptarupower.com</p>
<p>Shri Suresh Reddi Director L&amp;T Infrastructure Development Projects Limited (L&amp;T IDPL), L&amp;T Campus, TCTC Building, First Floor, Mount Poonamallee Road, Manapakkam, Chennai – 600089. <a href="mailto:csr@lntec.com">csr@lntec.com</a></p>	<p>Director, Torrent Power Ltd., Electricity House, Lal Darwaja, Ahmedabad – 380 001. <a href="mailto:kashyapdesai@torrentpower.com">kashyapdesai@torrentpower.com</a> <a href="mailto:NAMANSHAH@torrentpower.com">NAMANSHAH@torrentpower.com</a> <a href="mailto:MAYANKGUPTA@torrentpower.com">MAYANKGUPTA@torrentpower.com</a> <a href="mailto:KARNESHGHAGARE@torrentpower.com">KARNESHGHAGARE@torrentpower.com</a> <a href="mailto:VATSALPATEL@torrentpower.com">VATSALPATEL@torrentpower.com</a></p>
<p>The Engineer-in-Chief Power and Electricity Deptt., Govt. of Mizoram, Power House, Bara Bazar Aizwal- 796 001, Mizoram <a href="mailto:eincplanning@gmail.com">eincplanning@gmail.com</a> <a href="mailto:mizoplan@gmail.com">mizoplan@gmail.com</a></p>	<p>Shri Vijayanand Semletty Associate Director-Commercial &amp; Regulatory, Sekura 503A, Windsor, Off CST Road, Kalina Mumbai-400098 <a href="mailto:Vijayanand.Semletty@Sekura.in">Vijayanand.Semletty@Sekura.in</a></p>
<p>Chairman &amp; Managing Director Reliance Power Reliance Centre, Ground Floor 19, Walchand Hirachand Marg, Ballard Estate, Mumbai 400 001</p>	<p>Chairman &amp; Managing Director Meghalaya Energy Corporation Ltd. Lumjingshai Short Round Road Shillong- 793 001. <a href="mailto:directormeptcl@gmail.com">directormeptcl@gmail.com</a> <a href="mailto:cetranzemeptcl@gmail.com">cetranzemeptcl@gmail.com</a> <a href="mailto:apborkharpan@gmail.com">apborkharpan@gmail.com</a></p>
<p>Chief Engineer (P) Manipur Electricity Department Govt. of Manipur, Manipur Sectt. South Block, Imphal, Manipur- 795 001. <a href="mailto:md.mspcl@gmail.com">md.mspcl@gmail.com</a> <a href="mailto:ed.tech.mspcl@gmail.com">ed.tech.mspcl@gmail.com</a></p>	<p>Chairman &amp; Managing Director, NTPC Ltd. NTPC Bhawan, Core 7, Scope Complex 7, Institutional Area Lodhi Road, New Delhi-110003 <a href="mailto:cmd@ntpc.co.in">cmd@ntpc.co.in</a> <a href="mailto:amanna@ntpc.co.in">amanna@ntpc.co.in</a> <a href="mailto:kamalverma@ntpc.co.in">kamalverma@ntpc.co.in</a> <a href="mailto:shipratyagi@ntpc.co.in">shipratyagi@ntpc.co.in</a></p>
<p>Chief Engineer Nagaland Deptt. of Power Kohima 797 001</p>	<p>Chief Engineer (Power) Department of Power Govt. of Arunachal Pradesh</p>

<p>Nagaland  <a href="mailto:cetransgen@gmail.com">cetransgen@gmail.com</a>  <a href="mailto:asang.dcare@gmail.com">asang.dcare@gmail.com</a></p>	<p>Itanagar  (Arunachal Pradesh) – 791 111  <a href="mailto:setrans26@gmail.com">setrans26@gmail.com</a>  <a href="mailto:tktara@hotmail.com">tktara@hotmail.com</a></p>
<p>Chairman &amp; Managing Director  Block-1 Neyveli-607 801 NLC India Limited  Cuddalore District, Tamilnadu  <a href="mailto:cmd@nlcindia.in">cmd@nlcindia.in</a></p>	<p>Chairman &amp; Managing Director,  KEC International Limited,  RPG House, 463,  Dr. Annie Besant Road,  Worli, Mumbai – 400030  <a href="mailto:kecindia@kecrpg.com">kecindia@kecrpg.com</a></p>
<p>Director,  Darbhanga – Motihari Transmission Co. Ltd.  6th Floor, Plot No. 19  &amp; 20, Film City,  Sector 16 –A, Noida, Uttar Pradesh – 201301  <a href="mailto:Neeraj.Verma@SEKURA.IN">Neeraj.Verma@SEKURA.IN</a>  <a href="mailto:Nimish.Sheth@SEKURA.IN">Nimish.Sheth@SEKURA.IN</a>  <a href="mailto:Vijayanand.Semletty@Sekura.in">Vijayanand.Semletty@Sekura.in</a></p>	<p>Chairman and Managing Director,  M/s Juniper Green Transmission Private Limited    <a href="mailto:rohit.gera@junipergreenenergy.com">rohit.gera@junipergreenenergy.com</a>  <a href="mailto:rohit.gera91@gmail.com">rohit.gera91@gmail.com</a></p>
<p>Chairman &amp; Managing Director,  Tata Power,  NDPL House, Hudson Lines, Kingsway  Camp  Delhi-110 009  <a href="mailto:BD@tatapower.com">BD@tatapower.com</a>  <a href="mailto:vrshrikhande@tatapower.com">vrshrikhande@tatapower.com</a>  <a href="mailto:nitin.kumar@tatapower.com">nitin.kumar@tatapower.com</a>  <a href="mailto:neeraj.srivastava@tatapower.com">neeraj.srivastava@tatapower.com</a>  <a href="mailto:piyushkumar@tatapower.com">piyushkumar@tatapower.com</a></p>	<p>Chairman &amp; Managing Director,  M/s ReNew Transmission Ventures  Private Limited    <a href="mailto:anuj.jain@renewpower.in">anuj.jain@renewpower.in</a>  <a href="mailto:mohit.jain@renewpower.in">mohit.jain@renewpower.in</a>  <a href="mailto:amit.kumar1@renewpower.in">amit.kumar1@renewpower.in</a></p>
<p>Director,  M/s G R Infracore Limited    <a href="mailto:transmission@grinfra.com">transmission@grinfra.com</a>  <a href="mailto:ashwin@grinfra.com">ashwin@grinfra.com</a>  <a href="mailto:modassar.a@grinfra.com">modassar.a@grinfra.com</a></p>	<p>Chairman &amp; Managing Director,  M/s Apraava Energy Private Limited    <a href="mailto:naveen.munjal@apraava.com">naveen.munjal@apraava.com</a>  <a href="mailto:roshni.shah@apraava.com">roshni.shah@apraava.com</a>  <a href="mailto:sumit.sinha@apraava.com">sumit.sinha@apraava.com</a></p>
<p>CMD,  M/s Megha Engineering &amp; Infrastructures  Ltd.,    <a href="mailto:jsrinivaskumar@meilgroup.in">jsrinivaskumar@meilgroup.in</a></p>	<p>Shri I R Venkatraman  (Head &amp; VP - Regulatory &amp; Contracts)  Unit No. 101, First Floor, Windsor,  Village KoleKalyan, off CST Road,  Vidyanagari Marg, Kalina, Santacruz  (East), Mumbai – 400 098  <a href="mailto:venkatraman.inumula@indigrid.com">venkatraman.inumula@indigrid.com</a></p>
<p>Chairman &amp; Managing Director  Reliance Power, Reliance Centre, Ground  Floor, 19, Walchand Hirachand Marg,  Ballard Estate, Mumbai 400 001  <a href="mailto:reliancepower.ipo@relianceada.com">reliancepower.ipo@relianceada.com</a></p>	<p>Chairman  Gujarat Urja Vikas Nigam Ltd. Sardar  Patel Vidyut Bhawan, Race Course,  Vadodara- 390 007  <a href="mailto:md.guvnl@gebmail.com">md.guvnl@gebmail.com</a></p>
<p>Managing Director  Jammu &amp; Kashmir State Power Development  Corporation Ltd, PDD Building, Exhibition  Grounds, Opposite High Court, Jhangir</p>	<p>Shri Gulam Mir Mohd. Electric M &amp;RE  Division, Choglamsar, Leh-Ladakh194101  <a href="mailto:cepladakh@gmail.com">cepladakh@gmail.com</a></p>

Chowk, Srinagar (J&K) 190009 <a href="mailto:md@jkspdcl.com">md@jkspdcl.com</a>	
Commissioner-cum-Secretary(P) Andaman and Nicobar Electricity Department, Secretariat, Andaman and Nicobar Islands, Port Blair- 744 101 <a href="mailto:secyship14@gmail.com">secyship14@gmail.com</a>	Secretary Dadra & Nagar Haveli Electricity Department, Dadar Nagar Secretariat, Silvassa- 396230 <a href="mailto:tapasyaraghav@gmail.com">tapasyaraghav@gmail.com</a>
Secretary Lakshadweep Elec. Department U.T. of Lakshyadeep Kavaratti- 682555 <a href="mailto:lk-ktelect@nic.in">lk-ktelect@nic.in</a>	Secretary Puducherry Elec. Department Secretariat, Puducherry- 605001 <a href="mailto:secygs.pon@nic.in">secygs.pon@nic.in</a>
Chairman & Managing Director Neyveli Lignite Corporation Limited Corporate Office, Block -1 Neyveli – 607801 <a href="mailto:cmd@nlcindia.in">cmd@nlcindia.in</a>	Chairman & Managing Director NPCIL Nabhikiya Urja Bhavan, Anushaktinagar, Mumbai-400094 <a href="mailto:npciltecrect@npcil.co.in">npciltecrect@npcil.co.in</a>
Chairman & Managing Director THDC INDIA LTD. Pragatipuram, Bye Pass Road, Rishikesh 249 201 (Uttarakhand) <a href="mailto:cmd@thdc.co.in">cmd@thdc.co.in</a>	Chairman, Odisha Power Generation Corporation Ltd., Zone-A, 7th Floor, Fortune Towers, Chandrasekharapur, Bhubaneswar - 751023 Odisha, India <a href="mailto:energy@nic.in">energy@nic.in</a>
Managing Director Karnataka Power Corporation Limited No. 82, Shakthi Bhavan, Race Course Road, Bengaluru – 560001 <a href="mailto:mdkpcl@gmail.com">mdkpcl@gmail.com</a>	Chairman Jharkhand Urja Utpadan Nigam Ltd. Engineering Building, HEC Dhurwa, Ranchi-834004 <a href="mailto:mdjuunl2018@gmail.com">mdjuunl2018@gmail.com</a>
Chairman & Managing Director Pragati Power Corporation Limited Himadri, Rajghat Power House Complex, New Delhi – 110002 <a href="mailto:md.ipgpp@nic.in">md.ipgpp@nic.in</a>	Chairman & Managing Director West Bengal Power Development Corporation Ltd.(WBPDC) Bidyut Unnayan Bhavan, plot 3/C, LABlock, Sector-III, Salt Lake City, Kolkata - 700 098 <a href="mailto:wbpdc@wbpdcl.co.in">wbpdcl@wbpdcl.co.in</a>
Chief Engineer(Elect.) Goa Electricity Department Vidyut Bhawan, Panaji, Goa- 403001 <a href="mailto:cee-elec.goa@nic.in">cee-elec.goa@nic.in</a> <a href="mailto:elec.goa@nic.in">elec.goa@nic.in</a>	Chairman & Managing Director U.P. Rajya Vidyut Utpadan Nigam Ltd., Shakti Bhawan, 14- Ashok Marg, Lucknow 226001 <a href="mailto:cmd@upptcl.org">cmd@upptcl.org</a>
Managing Director Uttarakhand Jal Vidyut Nigam Ltd. Maharani Bagh, G M S Road, Dehradun, Uttarakhand- 248 00 <a href="mailto:mdujvnl@ujvnl.com">mdujvnl@ujvnl.com</a>	Managing Director Maharashtra State Power Generation Co. Ltd. Prakashgad, Plot No. G-9, 4th Floor Bandra (E), Mumbai-400051 <a href="mailto:md@mahagenco.in">md@mahagenco.in</a>
Chairman & Managing Director SJVN LIMITED Himfed Building, New	Chairman A.P. Power Generation Corporation Ltd.

Shimla 171 009 <a href="mailto:sectt.cmd@sjvn.nic.in">sectt.cmd@sjvn.nic.in</a> <a href="mailto:nandlal.sharma@sjvn.nic.in">nandlal.sharma@sjvn.nic.in</a>	Vidyut Soudha, Gunadala Eluru Road, Vijaywada Andhra Pradesh – 520 004 <a href="mailto:chairman@apgenco.gov.in">chairman@apgenco.gov.in</a>
Managing Director Madhya Pradesh Power Generating Co. Ltd. Shakti Bhawan, Vidyutnagar, P.O. Jabalpur- 482 008 <a href="mailto:mppgcl@mp.nic.in">mppgcl@mp.nic.in</a>	Managing Director Chhattisgarh State Power Generation Company Ltd., Vidyut Seva Bhawan P.O. Sunder Nagar, Danganiya, Raipur- 492 013(Chhattisgarh) <a href="mailto:mdgenco@cspc.co.in">mdgenco@cspc.co.in</a>
Managing Director Haryana Power Generation Corpn. Ltd. Urja bhawan, C-7, Sector-6 Panchkula, Haryana- 13410 <a href="mailto:md@hvpn.org.in">md@hvpn.org.in</a>	Chairman & Managing Director, Telangana StatePowerGeneration Corporation Limited, Vidyut Soudha, ‘A’ Block, Khairatabad, Hyderabad – 500 082 (Telangana) <a href="mailto:cmd@tsgenco.co.in">cmd@tsgenco.co.in</a>
Managing Director, Bihar State Power Generation Company Limited 5th Floor, Vidyut Bhawan, Bailey Road, Patna (Bihar) <a href="mailto:md.bspgcl@gmail.com">md.bspgcl@gmail.com</a>	Chairman Assam Power Generation corporation Ltd., Bijulee Bhawan, Paltan Bazar, Guwahati Assam <a href="mailto:managing.director@aegcl.co.in">managing.director@aegcl.co.in</a> <a href="mailto:md_aegcl@yahoo.co.in">md_aegcl@yahoo.co.in</a> <a href="mailto:asebchairman@gmail.com">asebchairman@gmail.com</a> <a href="mailto:cgm.ppd@aegcl.co.in">cgm.ppd@aegcl.co.in</a>
Managing Director Sikkim Power Development Corporation Ltd. 31-A, N.H. Way, Gangtok- -737 101 <a href="mailto:sikkim.serc@gmail.com">sikkim.serc@gmail.com</a>	Chief Engineer Nagaland Deptt. of Power Kohima 797 001 Nagaland <a href="mailto:secyit-ngl@nic.in">secyit-ngl@nic.in</a> <a href="mailto:vizo123@gmail.com">vizo123@gmail.com</a> <a href="mailto:cetransgen@gmail.com">cetransgen@gmail.com</a> <a href="mailto:asang.dcare@gmail.com">asang.dcare@gmail.com</a>
Chairman & Managing Director Tripura State Elec. Corporation Ltd. Govt. of Tripura, Bidyut Bhawan Agartala- 799 001 <a href="mailto:cmd.tsecl@rediffmail.com">cmd.tsecl@rediffmail.com</a> <a href="mailto:managing.director@tsecl.in">managing.director@tsecl.in</a> <a href="mailto:director.technical@tsecl.in">director.technical@tsecl.in</a> <a href="mailto:cmd.tsecl@rediffmail.com">cmd.tsecl@rediffmail.com</a>	Chief Engineer (Power) Department of Power Govt. of Arunachal Pradesh Itanagar (Arunachal Pradesh) – 791 111 <a href="mailto:vidyutarunachal@rediffmail.com">vidyutarunachal@rediffmail.com</a> <a href="mailto:vidyutarunachal@gmail.com">vidyutarunachal@gmail.com</a> <a href="mailto:setrans26@gmail.com">setrans26@gmail.com</a> <a href="mailto:tktara@hotmail.com">tktara@hotmail.com</a>
The Engineer-in-Chief Power and Electricity Deptt., Govt. of Mizoram, Power House, Bara Bazar Aizwal- 796 001, Mizoram <a href="mailto:eincpower@gmail.com">eincpower@gmail.com</a> <a href="mailto:eincplanning@gmail.com">eincplanning@gmail.com</a> <a href="mailto:mizoplan@gmail.com">mizoplan@gmail.com</a>	Chief Engineer (P) Manipur Electricity Department Govt. of Manipur, Manipur Sectt. South Block, Imphal, Manipur- 795 001 <a href="mailto:snandei@gmail.com">snandei@gmail.com</a> <a href="mailto:md.mspcl@gmail.com">md.mspcl@gmail.com</a> <a href="mailto:ed.tech.mspcl@gmail.com">ed.tech.mspcl@gmail.com</a>
Chairman & Managing Director Meghalaya Energy Corporation Ltd. Lumjingshai Short Round Road Shillong- 793	Chairman & Managing Director NEEPCO Ltd. Brookland Compund Shillong – 793 003

001 <a href="mailto:ewnong@yahoo.com">ewnong@yahoo.com</a> <a href="mailto:directormeptcl@gmail.com">directormeptcl@gmail.com</a> <a href="mailto:cetranzemeptcl@gmail.com">cetranzemeptcl@gmail.com</a>	<a href="mailto:vksnhpc@yahoo.co.in">vksnhpc@yahoo.co.in</a>
Chairman & Managing Director TANGEDCO 10th Floor/NPKR Ramasamy Malikai, No. 144, Anna Salai, Chennai – 600 002 <a href="mailto:chairman@tnebnnet.org">chairman@tnebnnet.org</a>	

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

Dated, 16<sup>th</sup> July, 2020

To

1. Chief Secretaries/ Administrators of all the States/UTs.
2. Chairperson, CEA, New Delhi- with a request to disseminate the above guidelines to all the stakeholders.
3. CMD, PGCIL, Gurgaon.
4. CMD, POSOCO, New Delhi.
5. Secretary, CERC, New Delhi.
6. CMD of State Power Utilities/ SEBs

**Subject: Guidelines for payment of compensation in regard to Right of Way (RoW) for transmission lines in urban areas.**

Sir,

In order to facilitate early resolution of Right of Way (RoW) issues for laying of transmission lines, Ministry of Power vide OM No. 3/7/2015-Trans dated 15th October, 2015 had issued the guidelines for payment of compensation towards damages with regard to Right of Way for transmission lines. The guidelines inter-alia had recommended compensation for 85% of the land value for tower footing and upto 15% of the land value for RoW of the line for transmission system of 66 kV and above voltage level. 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.

2. During a review meeting of critical transmission lines, taken by Secretary (Power), Govt. of India on 19.7.2016, it was inter alia decided to constitute a Committee under the chairmanship of Additional Secretary, Ministry of Power to analyse the issues relating 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. The Committee held several meetings to obtain the views of State Governments on the issue and submitted its Report along with the recommendations (copy of the Report is at **Annex-I**).

3. The recommendations made by the above Committee are hereby formulated in the form of following guidelines for determining the compensation in "Urban Areas" towards "damages" as stipulated in section 67 and 68 of the Electricity Act, 2003 read with Section 10 and 16 of Indian Telegraph Act, 1885, which will be in addition to the compensation towards normal crop and tree damages:

- i. Compensation @ 85% of land value as determined by District Magistrate or any other authority based on circle rate/ Guidelines value / Stamp Act rates for tower base area (area bounded by concrete as visible from outside of four legs of the towers) impacted severely due to installation of tower / pylon structure.
- ii. Compensation towards diminution of land value in the width of Right of Way (RoW) Corridor due to laying of transmission line and imposing certain restriction would be decided by the States as per categorization/ type of land in different places of States, subject to a maximum of 15 % of land value as determined based on Circle rate /Guidelines value/ Stamp Act rates.

- iii. In addition to the provisions mentioned at Para 3(i) and (ii) above, additional compensation in form of **Non-Usability allowance** up to 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.
- iv. For compensation purpose, the width of RoW corridor shall not be more than that prescribed in the Table 3 (summarized) in the **Annex-I** and for tower base, the compensation shall be paid for actual base width of tower (area bounded by concrete as visible from outside of four legs of the towers). The indicative base width of tower is given under column (12) in Table-3 (Detailed) of **Annex-I**.
- v. While making choice of technology to be used for laying of transmission lines in RoW constraint area, various technological options needs to be assessed keeping in view the reduction in RoW, feasibility of implementation, overall cost of laying the line. A tentative Cost matrix of the available technologies is attached as **Annex-II**. The same can be referred by the implementation agencies keeping in view the cost benefit aspects.
- vi. Payment of compensation shall be done through various digital modes of payment such as AADHAR enabled payment system (AEPS), Unified Payment Interface (UPI) etc. where feasible.
- vii. The payment towards compensation for RoW in urban areas would be onetime/upfront. In case of any other arrangement for payment of compensation, the same needs to be notified by individual states.

**Note:** For the purposes of these guidelines, Urban Area is defined as all places with a municipality, corporation, cantonment board or notified town area committee etc

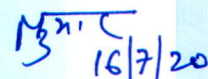
4. The above compensation amount will be payable only for transmission lines supported by a tower base of 66 KV and above, and not for sub-transmission and distribution lines below 66 KV in notified Urban Areas.

5 Necessary action may kindly be taken accordingly. These guidelines would not only facilitate an early resolution of RoW issues in urban areas but also facilitate completion of the vital transmission lines in urban areas through active support of State/ UT administration.

6 All the States/UTs etc are requested to take suitable decision regarding adoption of the guidelines considering that "Land" is a State subject.

Encl.: As above

Yours faithfully,

  
16/7/20

(Tanmay Kumar)

Joint Secretary (Trans)

Copy, along with enclosure, forwarded to the following:

1. Secretaries to the Government of India.
2. Prime Minister's Office.
3. Technical Director, NIC, Ministry of Power- with the request to host subject Guidelines on the website of Ministry of Power.
4. Copy to PS to Hon'ble MoSP (IC) / Secretary (Power) / AS (SKGR) / AS (SM) / AS&FA / All Joint Secretaries/ EA/ All Directors/DSs, Ministry of Power.

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**REPORT OF THE COMMITTEE FOR FINALISATION  
OF COMPENSATION IN REGARD TO RIGHT OF  
WAY (ROW) FOR TRANSMISSION LINES IN URBAN  
AREAS**



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# **Report of the Committee for finalisation of compensation in regard to Right of Way (RoW) for transmission lines in urban areas.**

## **1. Background**

- 1.1 The transmission of power on overhead line will continue to dominate over other mode of power transmission due to techno-economic considerations / reasons. Right of Way (RoW) compensation issue has become very critical and completion of many important transmission lines is held up due to stiff resistance from the landowners whose land falls in the RoW and demand of enhanced compensation. Hence, focus is to explore the possibilities of reduction / optimisation of transmission corridor width through various technological options.
- 1.2 The matter of RoW 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.
- 1.3 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 15<sup>th</sup> 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.
- 1.4 Further, MoP has constituted a committee 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.

## **2. Constitution of committee and Terms & reference of Committee**

- 2.1 Ministry of Power (MoP) vide letter no. 3/4/2016-Trans dated 11-08-2016 has constituted a committee under the Chairmanship of Ms Shalini Prasad, Additional Secretary Ministry of Power to analyse the issue relating 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 (**copy enclosed at Appendix-I**). The composition of the Committee is given below:

- (i) Ms. Shalini Prasad, Additional Secretary, Ministry of Power
- (ii) Smt. Jyoti Arora, Joint Secretary, Ministry of Power
- (iii) Chairperson/Member (PS). Central Electricity Authority
- (iv) Principal Secretary/Secretary (Energy) Govt. of Karnataka
- (v) Principal Secretary/Secretary (Energy) Govt. of Kerala
- (vi) Principal Secretary/Secretary (Energy) Govt. of Maharashtra
- (vii) Principal Secretary/Secretary (Energy) Govt. of U.P
- (viii) Principal Secretary/Secretary (Energy) Govt. of Haryana
- (ix) CMD PGCIL
- (x) Chief Engineer PSPA-I. CEA Convener & Member Secretary

2.2 The Terms of Reference (ToR) of the Committee include:

- (i) To review/analyse existing procedures for compensation and suggest possible modification to address following issues.
  - a. Possible changes in assessment process
  - b. Procedure for timely release of compensation payment
  - c. Measure to stop payment to ineligible persons
  - d. Possibilities of releasing certain percentage in advance to reduce resistance
- (ii) To suggest procedure to assess eligibility and subsequent compensation for structure/hut/bore well etc. including measure to ensure their shifting/removal after payment of Compensation.
- (iii) To explore possibility of enlarging scope of survey to include land scheduling for complete ROW width including name of land owners to facilitate payment of diminution of land value compensation to all eligible persons.
- (iv) To suggest strategy/mechanism for ensuring compliance/implementation by State Govt.
- (v) To explore possible methodology for direct online payment, say through Jan Dhan Yojana.
- (vi) To explore the technological options for reducing the tower footing/base, area/corridor requirements.
- (vii) To explore possibility of reduction of transmission corridor width/selective restricted use of corridor in urban zones by using technical advances/ raising heights of towers/ adequate safety measures/revisiting clearance requirements especially for 220 kV and 132 kV levels.

### 3. Proceeding of Committee

3.1 The 1<sup>st</sup> meeting of the Committee was held under the Chairmanship of Ms. Shalini Prasad, Additional Secretary, MoP on 30-08-2016 and the following decisions were taken after detailed deliberations.

- (i) CEA shall explore the different technical option available for further optimizing the Right of Way width, Safety clearances such as:
  - (a) New compact tower design
  - (b) Possibility of including caging of conductor in the existing/new tower to reduce swing of conductor.
  - (c) Feasibility of underground cable laying for EHV lines.
  - (d) Feasibility of Gas insulated lines.

The Minutes of Meeting (MoM) is enclosed at **Appendix-II**

3.2 As per decision of 1<sup>st</sup> meeting, Chief Engineer (PSP&PA-I), CEA and Convener & Member Secretary of the Committee had taken a meeting on 23-09-2016 to explore different technical options available for further optimizing the RoW width, safety clearances etc. After detailed deliberations, the broad parameters / factors were listed down (type of conductor, design span, conductor operating temperature, configuration of insulator string, swing angle, cage width, minimum safety clearance) to carry out the calculation of RoW for different voltage types and it was decided that M/s Powergrid, M/s Sterlite Grid Limited, M/s Kalpatru Power Transmission Ltd. and M/s Essel Infraprojects Limited shall furnish the calculations of RoW within a week's time.

The Minutes of Meeting (MoM) is enclosed at **Appendix-III**.

3.3 The 2<sup>nd</sup> meeting of the Committee was held under the Chairmanship of Ms. Shalini Prasad, Additional Secretary, MoP on 30-09-2016 and the following decisions were taken after detailed deliberations.

- (a) To further explore any other technological options available for reduction of RoW based on worldwide practices and the cost implication.
- (b) PGCIL to provide international practices for addressing the RoW issue in urban/populated/forest areas.
- (c) To explore the possibility of framing detailed guidelines to incorporate RoW consideration at micro planning stage and to explore various options for optimum utilization of the existing Row as far as possible right at planning stage
- (d) To explore the possibility of dividing the route of transmission lines into few broad categories such as normal route, route through Reserved forest area and route through Urban areas/Populated area and notifying different RoW for different category suggesting specific technical measures for urban/populated area/ forest areas.

The Minutes of Meeting (MoM) is enclosed at **Appendix-IV**

3.4 The 3<sup>rd</sup> meeting of the Committee was held under the Chairmanship of Ms. Shalini Prasad, Additional Secretary, MoP on 02-11-2016 and the following decisions were taken after detailed deliberations.

- (a) A committee comprising of representatives CEA, PGCIL, Maharashtra and Kerala will calculate and create matrix for RoW requirements considering all factors influencing the RoW (span, conductor, I/V string, swing angle) for one wind zone, say wind zone 4.
- (b) Chief Town planners or other concerned authority who is involved in town planning would be invited in the next meeting to discuss the provisions of RoW for laying of transmissions lines.
- (c) The next meeting is proposed for 21<sup>st</sup> November, 2016 for reviewing the calculation submitted by the committee.
- (d) The state utilities shall come out with suggestions regarding methodology for calculation of compensation.

The Minutes of Meeting (MoM) is enclosed at **Appendix-V**

3.5 In the 3<sup>rd</sup> meeting of the Committee, held on 02-11-2016, it was decided to constitute a Committee comprising representatives from CEA, PGCIL, Govt. of Kerala and Govt. of Maharashtra under the Chairmanship of Chief Engineer (PSE&TD), CEA, to study all the factors influencing the RoW for a particular Wind zone and to bring out the requirement for different combinations. Accordingly, a Committee was constituted with the following composition:

- (a) Chief Engineer (PSE&TD), CEA -Chairman
- (b) Chief Electrical Inspector, CEA
- (c) Representative of PGCIL
- (d) Representative of Govt. of Kerala
- (e) Representative of Govt. of Maharashtra

3.6 The 4<sup>th</sup> meeting of the Committee was held under the Chairmanship of Ms. Shalini Prasad, Additional Secretary, MoP on 08-12-2016. In the meeting, Chief Engineer (PSETD), CEA presented the RoW matrix prepared in consultation with POWERGRID and Kerala considering various factors (span, conductor, I/V string, swing angle) influencing the RoW for wind zone 4 and the following decisions were taken after detailed deliberations.

- (a) A sub-committee comprising of representatives from CEA, Punjab, Uttarakhand, Himachal Pradesh and TATA Power and few others would deliberate and finalise RoW requirements for 33 kV transmission lines
- (b) Deliberations to be held with Chief Town planners or other concerned authority, who are involved in town planning, to discuss about dedicated corridor for laying of transmission lines for greenfield projects.

- (c) CEA to consider framing of guidelines stipulating use of monopole structure / multi-circuit / multi-circuit & multi-voltage towers in urban areas and in approach section near substation. The use of such structures can be considered by Utilities for other areas based on economics.
- (d) CEA and PGCIL to prepare a Draft Report concluding the decisions taken by the Committee.
- (e) The issue regarding compensation methodology would be discussed further by MoP with state utilities.

The Minutes of Meeting (MoM) is enclosed at **Appendix-VI**.

3.7 The 5<sup>th</sup> meeting of the Committee was held on 08-02-2017 wherein the following decisions were taken:

- (a) Additional compensation in 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.
- (b) The RoW for 33 kV transmission lines as finalized by the 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.
- (c) After receipt of the comments from the members of the committee, the final report of the committee would be issued.
- (d) Chief Electrical Inspectorate, CEA would initiate / circulate a discussion paper allowing construction activity under the RoW of the transmission line.

The Minutes of Meeting (MoM) is enclosed at **Appendix-VII**.

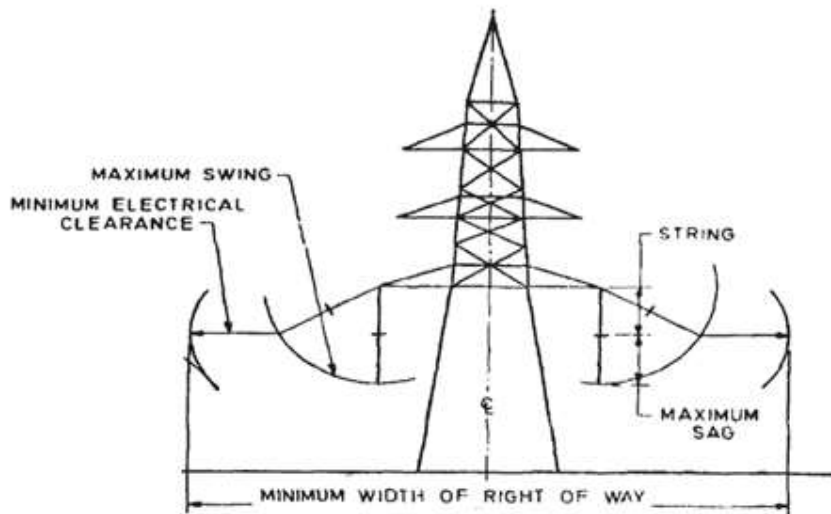
3.8 The committee constituted by MoP vide its OM dated 20.1.2017, under the chairmanship of Chief Engineer, PSPA-I, CEA to deliberate and finalise the Right of Way (RoW) requirements for lines at 33 kV level submitted its report on 07.04.2017. The same is enclosed at **Appendix-VIII**.

3.9 The 6<sup>th</sup> meeting of the Committee was held under the Chairmanship of Ms. Shalini Prasad, Additional Secretary, MoP on 09-05-2017. The recommendations made in the Draft Report for finalization of compensation concerning Right of Way (RoW) for transmission line falling in urban areas were circulated to the members of the Committee before the meeting. In the meeting, the recommendations made in the draft report were discussed item-wise and Members of the Committee were in agreement on the Draft Report except for some minor changes. The Committee members were requested to send their additional comments, if any, within a week so that the report could be released after incorporation of the same. No comment has been received from the Committee members.

The Minutes of Meeting (MoM) is enclosed at **Appendix-IX**.

#### 4. Detail Report

- 4.1 Generally, the transmission line towers are of two types (a) self-supporting type (lattice structure / steel pole structure) (b) Guyed type. In India, self-supporting lattice structures are being most commonly used for EHV transmission lines. In recent years, use of monopole structures are also increasing in specific areas due to much reduced footprints, less component and faster erection & commissioning. The high cost, difficulty in transportation, increase in number of poles due to reduction in design span, special design consideration for multi-circuit towers and limited manufacturing facility are some of the bottlenecks in construction of transmission lines with monopole structure.
- 4.2 Right of Way (RoW) is the strip of land immediately below and adjacent to a transmission line. The width of RoW required for a transmission line is based on the consideration for safety clearances as per CEA (Measures relating to safety and Electric supply) Regulations 2010, Electromagnetic Field (EMF) exposure limits and design consideration for tower structure. The RoW also provide an access corridor for maintenance of transmission lines,



- 4.3 As per current practice, the width of RoW / corridor requirement for the transmission lines of different voltage levels are as follows.

**Table -1**

Voltage Level	Corridor Requirement (m)
66kV AC	18
110kV AC	22
132kV AC	27

220kV AC	35
400kV AC Single Circuit (Horizontal configuration)	52
400kV AC Double Circuit / 400kV S/C (Vertical / delta configuration)	46
765kV AC Single Circuit (Horizontal configuration)	85
765kV AC Single Circuit (Delta / Vertical configuration)	64
765kV AC Double Circuit	67
1200kV AC	89
+/- 500kV HVDC	52
+/- 800kV HVDC	69

4.4 The current practice in India for RoW width / corridor requirement of transmission lines for various voltage level is more or less similar to worldwide practice.

4.5 Ministry of Environment & Forest (MOEF) guidelines also follow the above RoW width for transmission lines traversing through forest area. The various other provisions in MoEF guidelines relating to transmission lines are enclosed at **Appendix-X**.

4.6 RoW requirement for transmission line depends on following factors:

- a) Configuration of Tower [S/C (Horizontal / Delta / Vertical) or D/C (Vertical)]
- b) Span length
- c) Sag of Conductor, which depends on type of conductor used, maximum operating temperature of the conductor, and Span length
- d) Wind velocity and angle of swing
- e) Projection of Cross arm or distance of conductor attachment point from centre line of tower, which depends on wind velocity, swing angle, metal clearance, cage width or tower body width at bottom conductor level
- f) Minimum horizontal & Vertical safety clearance as per CEA (Measures relating to safety and Electric supply) Regulations, 2010.
- g) Configuration of insulators [I / V / Y configuration] and Length of insulator string
- h) Electric field limits below bottom most conductor and at edge of RoW

4.7 With the increasing operating voltage, the concern for the ground level electric field & magnetic field effects of overhead transmission lines have increased. The electric fields are especially important because their effects on human beings and animals has been a matter of concern. The minimum ground clearance for transmission lines dependent upon interference limits including Electric Field, Audible Noise (AN), Radio Interference (RI), Television Interference (TVI) etc. and become ruling condition specifically for



transmission lines of Voltage levels above 400 kV. International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines are generally being followed for the Electric & Magnetic field effect / exposure within the Right of Way (RoW). In India, Electric field limits below bottom most conductor and at the edge of the RoW at a height of about 1.8m above ground level is 10kV/m and 5kV/m respectively.

4.8 A matrix has been prepared for RoW under following assumptions:

- (a) Conventional ACSR conductor used at different voltage levels
- (b) Different design spans for normal route, forest areas and urban areas / approach section near the substation
- (c) Different insulator string configuration (I, V, Y type Insulator string configuration) for suspension type towers
- (d) Wind speed corresponding to Wind Zone -4, swing angle 35 degree and safe horizontal & vertical clearance as per CEA (Measures relating to safety and Electric supply) Regulations ,2010.

4.9 The RoW matrix provides values for following two conditions.

- Specifying RoW for different voltage level for calculation of compensation
- Specifying the safety clearance requirement including swing of conductor and giving opportunity for optimizing the design of tower for further reduction in RoW requirement.

4.10 The V-type / Y-type / I-type insulator string configuration are being used in suspension towers. It was reported that V-type insulator string configuration of insulators has some maintenance issues. The use of V-type insulator strings is not very common in EHV AC transmission lines and hence may be restricted to areas with constraints. But the V/Y type insulator string configuration is more commonly used in HVDC lines to meet high creepage distance requirement.

4.11 The detailed calculation for RoW requirement for various voltage levels in different areas is given at **Appendix-XI (Table -2)** and is summarized in **Table -3**.

4.12 The **Table-3 (Detailed)** provides RoW requirement for both insulator configurations (I / V type insulator configuration) for suspension towers as well as for tension towers for different voltage levels and span lengths. The maximum of three values i.e. I-type & V-type insulator string configuration (for suspension towers) and tension insulator strings (for tension towers) has been considered as the RoW in normal route without constraint. Similarly, the maximum of two values i.e V-type insulator string configuration (for suspension towers) and tension insulator strings (for tension towers)

has been considered as the RoW in forest areas and urban / populated areas / approach section near the substation. The maximum horizontal displacement of the conductor due to its swing for different voltage levels and for different span, beyond the conductor attachment point on either side of the tower, has been given as “H” in the Table-2. The maximum horizontal distance of bottom conductor attachment point from centre of tower is also given under **column (7)** in the **Table-3 (Detailed)** for different voltage levels. This dimension can be optimized to reduce the overall ROW. Similarly, the base width of the tower can be optimized.

4.13 The individual span along the route of the transmission line is generally different from design span. It is not desirable to calculate RoW requirement based on individual span for the purpose of compensation payment as it will be extremely difficult and practically impossible to calculate compensation on case to case basis. The process will be very complex, non-uniform across the country and it may lead to increase in legal disputes. Hence although reduction in RoW is achievable by optimization of the tower design or by adoption of various technological options, **but Compensation in different areas shall be paid for RoW as given at Table-3 (Summarized) / under column (10) in the Table-3 (Detailed) for different voltage levels.** Similarly, the base width of the tower can be optimized, but the **compensation shall be paid for actual base width (i.e leg to leg) of tower.** The indicative base width of tower is given under column (12) in the **Table-3 (Detailed)** for different voltage levels. However, the transmission licensees have the option to optimize the tower design / dimension to compensate additional amount paid towards compensation.

4.14 The constraint in getting the required RoW for construction of overhead transmission line is a matter of serious concern for all utilities. Reduction in RoW is essential, particularly in urban areas / populated areas and forest areas. Adoption of various technical measures is required, particularly in forest areas, and urban / populated areas, as availability of transmission corridor has become extremely difficult. Utilities are forced to consider various technological options for optimization and optimum utilisation of RoW. Various technological options available for optimisation and optimum utilization of RoW including urban / forest areas are as follows:

- a) Reduction in Span length
- b) Reduction in foot print of tower base [i.e use of Steel pole structure, Narrow based lattice structure]
- c) Use of V- type insulator strings for suspension towers and use of tension towers
- d) Use of multi-circuit and multi-circuit & multi-voltage towers
- e) Use of lattice / Steel pole structure with one side stringing
- f) Use of XLPE cable or Gas Insulated Transmission Line (GITL), GITL shall be exclusively used for high power transmission and where multi cable per phase is required.
- g) Use of compact towers with insulated cross arm
- h) Use of covered conductors upto 66kV level

- i) Upgrading of the existing line to higher voltage AC / converting to HVDC or uprating with high Ampacity conductor [High Temperature (HT) / High Temperature Low Sag (HTLS)] in the existing corridor
- j) Use of multi-circuit / multi-voltage with raised tower height to save trees (without cutting of trees) maintaining required safety clearance over the trees [e.g. multi-circuit & multi voltage tower used in Jaldapara Reserve forest area executed by PGCIL]
- k) Exploring the possibility of use of Voltage Source Converter (VSC) based HVDC transmission on overhead line or underground cable

**5. Recommendations for laying of transmission lines 66 kV and above in urban/populated area/ forest area in the country**

**5.1. To review/analyse existing procedures for compensation and suggest possible modification.**

- a) Ministry of Power, Govt. of India vide its letter dated 15-10-2015, has issued guidelines for determining the compensation payable towards “damages” as stipulated in Indian Telegraphic Act, in addition to the compensation towards normal crop and tree damages. This amount will be payable for transmission lines for 66kV and above and not for sub-transmission and distribution lines below 66kV voltage level. The recommendations regarding compensation values in the guidelines are given below:
  - (i) Compensation @85% of land value as determined by District Magistrate or any other authority based on circle rate / Guideline value / Stamp Act rates for tower base area (between four legs) impacted severely due to installation of tower / pylon structure;
  - (ii) Compensation towards diminution of land value in the width of RoW corridor due to laying of transmission line and imposing certain restriction would be decided by the states as per categorization / type of land in different places of states, subject to a maximum of 15% of land value as determined based on circle rate / Guideline value / stamp Act rates;

The above recommendation are yet to be adopted by most of the States.

- b) Additional compensation in 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.
- c) Onetime compensation for RoW for urban area / forest areas. But in case of rural areas, the compensation for RoW could be one time or on annuity basis for a

period of 10-20 years with option to pre-close the annuity payment by disbursing a lump sum amount on a mutually agreed terms.

5.2. ***To suggest procedure to assess eligibility and subsequent compensation for structure/hut/bore well etc. including measure to ensure their shifting/removal after payment of Compensation.***

- (i) The transmission line routing to be done to avoid any structure/hut/borewell etc. Necessary safety clearances needs to be maintained as per CEA (Measures relating to Safety and Electric Supply) in case of unavoidable circumstances.

5.3. ***To explore possibility of enlarging scope of survey to include land scheduling for complete ROW width including name of land owners to facilitate payment of diminution of land value compensation to all eligible persons.***

- (i) The Committee suggested to include the name of landowners along the RoW of the transmission line after carrying out the check survey at the time of execution.

5.4. ***To suggest strategy/mechanism for ensuring compliance/implementation by State Govt.***

- (i) The respective state government are advised to adopt the guidelines on RoW compensation.

5.5. ***To explore possible methodology for direct online payment, say through Jan Dhan Yojana.***

- (i) Committee suggested payment of compensation through various digital modes of payment such as Aadhar enabled payment system (AEPS), Unified Payment Interface (UPI) etc., where feasible.

5.6. ***To explore the technological options for reducing the tower footing/base, area/corridor requirements &***

5.7. ***To explore possibility of reduction of transmission corridor width/selective restricted use of corridor in urban zones by using technical advances/raising heights of towers/adequate safety measures/revisiting clearance requirements especially for 220 kV and 132 kV levels.***

- (i) The Route of transmission line (66kV and above voltage level) can be divided into three (3) broad sections / categories.
  - Normal Route of the line without constraint
  - Route of the line through forest area

- Route of the line through Urban areas/Populated area/approach section near substations.
- (ii) The design span at different voltage levels, depending on the terrain / areas (specified above) through which the transmission line traverses, shall be as follows:

**Table-4**

Voltage level	Design Span (m)		
	Normal Route without constraint	Forest area	Urban areas / Populated area / approach section near substation
765kV & 400kV	400	300	250
220kV / 230 kV	350	250	200
132kV / 110 kV	320	200	150
66kV	250	150	100

- (iii) In case of EHV AC transmission lines, the use of V-type insulator string configuration (on suspension towers) shall be restricted to areas with constraints. It is recommended to use suspension towers with V- type insulator string and / or tension towers in urban and forest area to reduce RoW.
- (iv) The RoW to be considered for compensation, in different areas for transmission lines at different voltage levels, is given at **Table 3 (Summarized)** and under column (10) in the **Table-3 (Detailed)**. The conductor sag at maximum operating temperature is independent of wind zones and while calculating RoW width requirement, a reasonable swing of conductor (35 degree) has been considered. Therefore, the indicated RoW width is applicable for all wind zones. The base width of the tower can be optimized, but **the compensation shall be paid for actual base width (i.e leg to leg) of tower**. The indicative base width of tower given under column (12) in the **Table-3 (Detailed)** for different voltage levels. However, the transmission licensees have the option to optimize the tower design / dimension.
- (v) For  $\pm 500$  kV HVDC,  $\pm 800$  kV HVDC and 1200 kV HVAC lines, the reduction in RoW ( 52 m , 69 m and 89 m respectively) is not possible as it violates the minimum electrical field requirement at the edge of RoW (i.e 5kV/m at 1.8m height)

- (vi) CEA (Technical Standard for Construction of Electric Plants and Electric Lines) Regulations and CEA (Measures relating to safety and Electric supply) Regulations, 2010, which are under revision, shall include RoW requirement at different voltage levels and shall mandate use of steel pole structure / multi-circuit / multi-circuit & multi-voltage towers in urban areas and in approach section near substation for effective use of available corridor.
- (vii) The transmission licensees have the flexibility to use appropriate technology options such as Use of steel pole structure, narrow based lattice towers, multi-circuit & multi-voltage towers, lattice / steel pole structure with one side stringing, XLPE cable or GITL, compact towers with insulated cross arm, , multi-circuit / multi-voltage with raised tower height, and VSC based HVDC transmission on overhead line or underground cable etc. depending upon the constraints encountered in availing RoW in different areas.
- (viii) The 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 brownfield 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.

**6. Recommendations for RoW requirement for laying of 33 kV transmission line.**

- 6.1. 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 pole	250	"I" String/Suspension	15 meter
			Tension	
		150	"I" String/Suspension	12 meter
			Tension	
		100	Pin Insulator	9 meter

	(Concrete Pole/Rail pole/H pole/ Single steel pole)	60	Pin Insulator	8 meter
Covered	Pole	100		6 meter

- 6.2. 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 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.
- 6.3. 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,2010.

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

Dated, 11<sup>th</sup> August, 2016

**OFFICE MEMORANDUM**

Subject:- Constitution of the Committee for finalization of compensation in regard to Right of Way (RoW) for transmission lines in urban areas.

The undersigned is directed to inform that during a review meeting of critical transmission lines, taken by Secretary (Power), Govt. of India on 19.7.2016, it has *inter alia* been decided to constitute a Committee under the chairmanship of Ms. Shalini Prasad, Additional Secretary, Ministry of Power to analyse the issues relating 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.

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

- 1 Ms. Shalini Prasad, Additional Secretary, Ministry of Power – Chairperson
- 2 Smt. Jyoti Arora, Joint Secretary, Ministry of Power
- 3 Chairperson/ Member (PS), Central Electricity Authority
- 4 Principal Secretary/ Secretary (Energy), Govt. of Karnataka
- 5 Principal Secretary/ Secretary (Energy), Govt. of Kerala
- 6 Principal Secretary/ Secretary (Energy), Govt. of Maharashtra
- 7 Principal Secretary/ Secretary (Energy), Govt. of UP
- 8 Principal Secretary/ Secretary (Energy), Govt. of Haryana
- 9 CMD, PGCIL
- 10 Chief Engineer, PSPA-I, CEA - Convener & Member Secretary

3. Committee may invite representatives from various power utilities in its meetings, as and when deemed necessary.

4. Terms of Reference (ToR) of the committee include:

1. To review/ analyse existing procedures for compensation and suggest possible modification to address following issues:
  - a) Possible changes in assessment process;
  - b) Procedure for timely release of compensation payment;
  - c) Measures to stop payment to ineligible persons;
  - d) Possibilities of releasing certain percentage in advance to reduce resistance.
2. To suggest procedure to assess eligibility and subsequent compensation for structure/ hut/ bore well etc. including measure to ensure their shifting/ removal after payment of compensation.

Contd...



3. To explore possibility of enlarging scope of survey to include land scheduling for complete RoW width including name of land owners to facilitate payment of diminution of land value compensation to all eligible persons.
  4. To suggest strategy/ mechanism for ensuring compliance/ implementation by State Govt.
  5. To explore possible methodology for direct online payment, say, through Jan DhanYojna.
  6. To explore the technological options for reducing the tower footing/ base area/ corridor requirements.
  7. To explore possibility of reduction of transmission corridor width/ selective restricted use of corridor in urban zones by using technical advances/ raising heights of towers/ adequate safety measures/ revisiting clearance requirements especially for 220 kV and 132 kV levels.
5. The Committee shall submit the report within two months.

(Ghanshyam Prasad)  
Director (Trans)  
Tele: 011-2371 6674

To,

- 1 Chairperson/ Member (PS), Central Electricity Authority
- 2 Principal Secretary/ Secretary (Energy), Govt. of Karnataka
- 3 Principal Secretary/ Secretary (Energy), Govt. of Kerala
- 4 Principal Secretary/ Secretary (Energy), Govt. of Maharashtra
- 5 Principal Secretary/ Secretary (Energy), Govt. of UP
- 6 Principal Secretary/ Secretary (Energy), Govt. of Haryana
- 7 CMD, PGCIL
- 8 Chief Engineer, PSPA-I, CEA.

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Copy to: PPS to Secretary (Power)/ SS (BPP)/ AS (SP)/ JS (Trans)/ Director (Trans)/ US (Trans), Ministry of Power.

### **Minutes of the meeting taken by Ms. Shalini Prasad, Additional Secretary, Ministry of Power on 30.08.2016 regarding finalization of compensation in regard to Right of Ways (RoW) for transmission lines in urban areas.**

List of participant is placed at **Annex-I**.

2. Additional Secretary, MoP, welcomed the participants and informed that the Right of Way compensation issue has become very critical and completion of many important transmission lines is held up due to severe resistance and demand of enhanced compensation.
3. Joint Secretary(Trans), MoP informed that the guidelines issued vide MoP letter dated 15.10.2015 is a stepping stone towards resolving complex RoW compensation issue and emphasized for its adoption by the States. She also enquired about the steps taken by Karnataka for resolving the compensation issue relating to many PGCIL lines held up in and around Bangalore. She also enquired about the initiative taken by Kerala for reduction/optimization of RoW width through a design based bid for 400 kV lines which has shown promising result and could achieve reduction in width of RoW by 10 m approx.
4. Chief Engineer (PSPA-I), CEA informed that various technical options viz. narrow based towers, multi circuit towers, mono pole towers with only one side stringing, XLPE cables, and gas insulated lines along with other technological interventions are being explored for optimizing RoW. Raising height of towers by having additional extension may also be considered. However, heavy financial implications associated with such technologies needs to be considered for project's economic viability.
5. ED, PGCIL explained the measures taken by POWERGRID for resolving the issue through technical measures like installing pole type, multi-circuit towers in and around major towns. PGCIL also made a brief presentation on RoW compensation issues vis-à-vis legal requirements and actual ground conditions.
6. Additional Chief Secretary, Karnataka and CMD, MAHATRANSCO informed that with the existing 85% and 15% provision, ROW clearance in metro cities shall not be possible as the land cost in metros, particularly in Bangalore, Mumbai and Pune are phenomenally high. They suggested CEA to come out with the design which reduces the restriction for building in the Right of Way. After deliberation, it was agreed that CEA will review the safety guidelines issued in 2010 to further optimize the restriction on account of electrical clearance.
7. CMD MAHATRANSCO also stated that since diminution of land value in case of rural areas is lesser as compared to urban areas, possibility for different compensation level for corridors may also be explored.
8. Director (Trans), Kerala informed that they are implementing an innovative technology by using special design of towers and High performance conductors such as High Temperature Low Sag (HTLS) conductors that will not only reduce the footprint of the towers but will also reduce the Right of Way requirement. She further stated that the prototype test of such tower is lined up in approaching months. Further, she expressed her view that for high voltage line in urban area we may consider reduced RoW through reduced span or by using Monopole towers. She also

suggested that a comprehensive analysis may be carried out for looking into viability of upgrading existing line by various technological initiatives.

9. Superintending Engineer (SE), HVPN informed that around Panchkula they have constructed special Multi-circuit towers of 66 kV which have resulted in tremendous saving of ROW as well as provision for future expansion. They also informed that they are going to replicate the scheme in Yamuna Nagar district and requested committee to visit Panchkula for on the spot review/assessment.

10. PGCIL informed that they have already taken a policy decision to use Multi-circuit tower for all incoming and outgoing lines up to 2 km to reduce ROW requirement and impact on agriculture land around the substation.

11. Additional Secretary, MOP desired that an advisory regarding reserving a dedicated corridor for transmission line be issued to the town planners for all upcoming/planned new cities & towns. She also enquired about the criteria adopted for locating EHV substations around major towns and emphasized that as far as possible such substations be located away from urban/semi-urban areas.

12. After detailed deliberations on various issues, following decisions were taken:

- i) CEA shall explore the different technical option available for further optimizing the Right of Way width, Safety clearances such as:
  - a) New compact tower design.
  - b) Possibility of including caging of conductor in the existing/ new tower to reduce swing of conductor.
  - c) Feasibility of underground cable laying for EHV lines.
  - d) Feasibility of Gas insulated lines.

It was also decided that CEA shall give a presentation on various technical options available, in the next meeting of the Committee.

- ii) The other Ministries/Departments which deal with the different type of linear utilities like Urban Development, Railways, and Irrigation etc. may be asked to explore possibilities of including margin/space for transmission/ distribution line while planning such linear projects.
- iii) Joint Secretary, MoP asked all member states to provide brief write up on possible solutions/ measures on compensation issue to CE, CEA and ED, PGCIL.
- iv) Decision regarding inviting representative from Ministry of Urban Development, Railway, and Road etc. shall be taken at appropriate time after reviewing the proposed technical measures.

13. Meeting ended with a vote of thanks to chair.

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Date/time of the meeting: 30.08.2016 at 11.00 am  
Venue: Ministry of Power, NPMC Room  
Shram Shakti Bhawan, New Delhi-110001

Sub: First meeting of the committee for finalization of compensation in regard to  
Right of Way (RoW) for transmission line falling in urban areas.

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**List of Participants**

**Ministry of Power**

1. Ms. Shalini Prasad, Additional Secretary - In the chair
2. Smt. Jyoti Arora, Joint Secretary (Trans)

**Central Electricity Authority (CEA)**

3. Shri K.K. Arya, Chief Engineer (PSPA-I)  
Phone: 26102045/Email: kkarya\_2001@rediffmail.com
4. Shri Awdhesh Kumar Yadav, Director  
Phone: 26732318/Email: awd.cea@gmail.com

**Power Grid Corporation of India Limited (PGCIL)**

5. Shri Atul Trivedi, ED  
Mobile: 9873549029/Email: atul.trivedi@powergridindia.com
6. Dr. R.K. Srivastava, AGM (ESMD)  
Mobile: 9910378134/Email: rks@powergridindia.com

**STATE SECTOR**

**Govt. of Karnataka, Bengaluru**

7. Shri P. Ravi Kumar, Addl. Chief Secretary (Energy)  
Phone: 080-22252373/Mobile: 09448124242  
Email: prs-energy@karnataka.gov.in
8. Shri A.K. Tiwari, Resident Commissioner  
Mobile: 9868393900/Email: rckarnatakanewdelhi@gmail.com

**Govt. of Maharashtra/MAHATRANSCO**

9. Shri Rajeev Kumar, CMD  
Phone: 022-26591253/26595000/Fax: 022-26598595/Mob:09769446924  
Email: md@mahatransco.in
10. Shri Chavan R.D., Director (Projects)  
Mobile: 09769006280/Email: dirprj@mahatransco.in

**Government of Uttar Pradesh/UPPTCL, Lucknow**

11. Shri Ravi Prakash Dubey, CE (TW)  
Mobile: 09412749801/Email: director\_project@upptcl.org, cetw@upptcl.org
12. Shri Yatendra Kumar, SE

**Government of Kerala**

13. Smt. VijayaKumari P., Director (Transmission)  
Mobile: 09446008444/Email: mtkseb@ksebnet.com

**Government of Haryana/HVPNL**

14. Shri Kuldeep Singh, SE/TS Panchkula  
Mobile: 09316369271/Email: setshvnpkl@gmail.com

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**Minutes of the meeting taken by Chief Engineer (PSP&PA-I), CEA on 23.09.2016 to explore the different technical options available for optimizing the Right of Way width for transmission lines**

List of participants is enclosed at **Annexure-I**.

Chief Engineer (PSP&PA-I) welcomed the participants and informed that a Committee that has been constituted under chairmanship of Ms. Shalini Prasad, Additional Secretary, Ministry of Power (MoP) regarding finalization of compensation in regard to Right of Way (RoW) for transmission line in Urban areas. In the first meeting of the Committee held on 30.08.2016, it was inter-alia decided that CEA shall explore different technical options available for further optimizing the Right of Way width, Safety clearances such as:

- a) New compact tower design.
  - b) Possibility of including caging of conductor in the existing/ new tower to reduce swing of conductor.
  - c) Feasibility of underground cable laying for EHV lines.
  - d) Feasibility of Gas insulated lines etc.
2. Director (PSP&PA-I) stated that the relevant Terms of Reference of the Committee, that needs to be deliberated are:
- (i) To explore the technological options for reducing the tower footing /base area/ corridor requirements
  - (ii) To explore possibilities of reduction of transmission corridor width/selective restricted use of corridor in urban zones by using technical advances /raising heights of towers/adequate safety measures/revisiting clearance requirements especially for 220 kV and 132 kV levels.

He requested all the transmission licensees to share their suggestions based on their field experience.

3. Chief Engineer, PSETD, CEA stated that the developers have the flexibility to use appropriate technology such as special tower design and configuration, HTLS Conductors, varied span length etc depending upon the constraints encountered by them in availing RoW in different areas. However, in order to optimize the area for which compensation needs to be paid by the developer, there is a need to recalculate the RoW width for different voltage lines. He further stated that possibility of reduction in RoW should be explored based on certain logical considerations like average design span, type of conductor, swing angle etc. meeting electrostatic field and safety clearance requirement. Once the RoW corridor width is generalized, further optimization of ROW by reduction of span length and use of tension towers etc., may be considered for forest and urban areas.

The reduction in RoW on case to case basis will be difficult to implement.

4. Director (EI), CEA stated that first we need to identify the factors that determines the width of RoW and then explore the technical options that could be used for optimizing/ minimizing each factor to achieve overall reduction in the RoW requirement. After discussions among all the participants, following options emerged out:

S.no	Factors contributing to the RoW width	Options available for optimization of RoW
1.	Configuration of the Tower	a) Use of Narrow Base Multi circuit Tower b) Use of different voltage levels on Multi circuit tower
2.	Live Metal Clearance	No options available for optimization as clearances are to be maintained as per Standards
3.	Horizontal Clearances	No options available for optimization as Horizontal Clearance based on Safety norms cannot be compromised.
4.	Swing and Sag	a) Use of V Suspension String b) Use of HTLS Conductor c) Use of Tension tower d) Tower span

5. After detailed deliberations, the broad parameters/factors were listed down (enclosed at **Annexure II**) to carry out the calculation of RoW for different voltage types and it was decided that M/s Powergrid, M/s Sterlite Grid Limited, M/s Kalpatru Power Transmission Limited and M/s Essel Infraprojects Limited shall furnish the calculations of RoW within a week's time at the following email ids:
  - (i) [kkarya\\_2001@rediffmail.com](mailto:kkarya_2001@rediffmail.com)
  - (ii) [skrmohapatra@rediffmail.com](mailto:skrmohapatra@rediffmail.com)
6. Director (PSP&PA-I) stated that during the meeting on 30.08.2016 it was also agreed that CEA will review the safety guidelines issued in 2010 to further optimize the restriction on account of electrical clearances. Director (EI), CEA clarified that under section 61 of the Central Electricity Authority (Measures relating to Safety and Electric Supply), Regulations 2010 it is mentioned that - An overhead line shall not cross over an existing building as far as possible and no building shall be constructed under an existing overhead line. And there is no scope of reduction in clearances as the human safety is involved.
7. Chief Engineer (PSP&PA-I), CEA stated that in areas where corridor is too congested for construction of overhead transmission lines, alternatives such

as XLPE cable and Gas Insulated line can be explored.

8. The representative of M/s Siemens Ltd. gave a brief presentation on GIL wherein he apprised the participants of the applications where use of GIL can offer a better solution and the areas where GIL proves better than EHV cable. GIL needs no reactors upto 70 km, requires no maintenance once installed and offers adequate overload capability.

The meeting ended with thanks to chair

## Annexure-I

**List of participants of the Meeting held on 23.09.2016 at CEA to explore the different technical options available for optimizing the Right of Way width for transmission lines.**

<b>Sl. No.</b>	<b>Name Shri/Smt</b>	<b>Designation</b>
1.	K.K.Arya	- Chief Engineer (PSP&PA-I), CEA- in chair
2.	S. K. Ray Mohapatra	- Chief Engineer (PSETD), CEA
3.	Awdhesh Kumar Yadav	- Director (PSP&PA-I), CEA
4.	Upendar Kumar	- Director, CEA
5.	Manjari Chaturvedi	- Dy. Director, CEA
6.	Santosh Kr. Yadav	- Dy. Director, CEA
7.	Shiva Suman	- Dy. Director, CEA
8.	C.N. Devarajan	- Dy. Director, CEA
9.	Priyam Srivastava	- Assistant Director, CEA
10.	Vikas Sachan	- Assistant Director, CEA
11.	Nitin Deswal	- Assistant Director, CEA
12.	A.K. Vyas	- Addl. GM, PGCIL
13.	Raj Kumar Singh	- Asstt. GM, PGCIL
14.	Vijay Pal	- Sr. Consultant, WAPCOS
15.	T.A.N. Reddy	- VP, Sterlite Power Ltd.
16.	S.G. Mohanty	- AVP, Sterlite Power Ltd.
17.	Bigyan Parija	- AVP, Sterlite Power Ltd.
18.	J. Raghu Ram	- GM, Sterlite Power Ltd.
19.	D.K. Ashok	- Manager (Engg.), Sterlite Power Ltd.
20.	Rajiv Kesarwani	- Sr, Manager, Kalpatru Power Transmission Ltd.
21.	P.K. Chaubey	- VP, Manager, Kalpatru Power Transmission Ltd.
22.	Neeraj Verma	- Manager, ESSEL INFRA Ltd.
23.	Dinesh Parakh	- GM (Comm), Patran Transmission Co. Ltd.
24.	Ramesh Bahri	- CEO, Techno Electric & Engineering Co. Ltd.
25.	Bhaskar Roy	- Manager, Siemens Ltd.



Parameters freezed for undertaking calculation of RoW width for different Voltage Levels											
S.no	Parameters affecting RoW	Voltage Levels									
		66 kV D/C	110 kVD/C	132 kVD/C	220 kVD/C	400 kVD/C	500 kV HVDC	800 kV HVDC	765 kV S/C (Horizontal/Delta)	765 kV D/C	1200 kV S/C
1	Type of Conductor	Wolf	Panther	Panther	Zebra	Twin/Quad Moose	Quad Lapwing	Hexa Lapwing	Quad Bersimis	Hex Zebra	Octa Moose
2(a)	Design Span (in metres)	250	320	320	350	400					
(b)		200				250					
3	Conductor Operating Temperature	85 degrees Centigrade (maximum)									
4	String type	I String				I & V String both					
5	Cage Width	Narrow Base & Conventional broad base towers. Tower outline diagram showing various dimensions and clearances with maximum swing									
6	Swing Angle	35 degrees									
7 (a)	Minimum Safety (line conductor to ground object) Clearances	To withstand Lightning Surges				To withstand Switching surges					
(b)		Minimum horizontal clearances as per Safety Regulations									

**Minutes of the Second meeting of the committee for finalization of compensation in regard to Right of Way (RoW) for transmission line falling in urban areas taken by Ms. Shalini Prasad, Additional Secretary Ministry of Power (MoP) on 30.09.2016**

**List of participants is placed at Annex-I.**

2 Additional Secretary, MoP welcomed the participants and stated that the Committee in its first meeting decided that for long-term solution on the issue of finalization of compensation in regard to Right of Way (RoW) for transmission line falling in urban areas, two pronged approach is needed i.e.

- Technical measures for reduction of RoW width to reduce the area of impact
- Revised principles for calculating compensation

Chief Engineer, CEA was requested to make a brief presentation on the technical measures.

3. Chief Engineer (PSP&A-I), CEA informed that a meeting was convened was on 23.09.2016 with different transmission licensees to explore the different technical options available for optimizing the Right of Way width for transmission lines. The possibilities of reduction of transmission corridor width and optimum use of corridor in urban zones by using various technological options like raising heights of towers maintaining adequate safety clearance using monopole structures, multi-circuit multi-voltage transmission towers, use of HTLS conductors, use of Gas insulated lines (GIL) / XLPE cable etc were discussed. M/s Powergrid, M/s Sterlite Grid Limited, M/s Kalpatru Power Transmission Limited and M/s Essel Infra projects Limited have been entrusted with the task of furnishing the calculations of RoW for different voltages within a week's time based on the broad parameters/factors like Type of conductor, Design Span, string type, swing angle, meeting safety clearance and electrostatic field requirement. These parameters were finalized during the meeting held on 23.9.2016 held in CEA.

4. Chief Engineer (PSETD), CEA made a brief presentation (copy enclosed as **Annexure II**) apprising the members of the Committee about the

- Options available for optimization and Optimum utilization of RoW including Urban / Forest areas and ;
- Revisions currently being undertaken by CEA in the Regulations on Safety and Technical Standard for construction of Electric Lines for addressing growing congestion in existing corridor of transmission network and RoW problems.

He further suggested that there is a possibility of dividing the route of transmission line into three broad categories such as normal route, Route through Reserved forest areas and Route through Urban areas/Populated areas and notifying different RoW for different category. Specific technical measures may be taken in forest areas and urban areas /populated areas for optimization / optimum utilization of existing RoW.

5. Joint Secretary, MoP stated that there is a need to explore more such innovative solutions like Gas Insulated transmission lines for urban / city areas like Bengaluru where cost is not the major issue but availability of RoW / transmission corridor is extremely difficult. She asked CEA, Powergrid and states to look into the worldwide / international practices to overcome such problem and come out with other technical options vis-à-vis comparison of their cost.

6. Representative from Haryana stated that there is a need to incorporate RoW consideration right from micro planning stage and various options should be explored for optimum utilization of the existing RoW as far as possible. The capacity of existing transmission lines with lower capacity of conductors can also be increased by increasing the size of the conductor or using higher capacity conductors or using multi circuit towers. Before planning new transmission system, the existing capacity should be optimally utilized by upgrading the transformers as well as existing transmission lines in the existing

ROW.

7. Representative from UP stated that more & more use of narrow based towers, monopoles, re-conductoring with HTLS conductors (wherever feasible)etc should be considered. It would be preferable to reduce the number of transformation level i.e. going for 220/33 kV substations instead of 220/132/33 kV sub-stations (eliminating 132kV level).
8. Joint Secretary, MoP asked CEA to explore the possibility of coming out with some detailed guidelines with regard to Inclusion of Narrow Base, monopole towers, Multi circuit towers, use of with high ampacity conductors right from the planning stage keeping in view future RoW constraints.
9. Representative from Powergrid and KPTCL suggested for modifying the safety Regulations of CEA for allowing construction of buildings upto a certain height under an overhead line in urban areas keeping adequate safety margin by raising of towers heights.
10. Director (CEI), CEA disagreed with the above proposal of Powergrid stating that vertical and horizontal clearance are primarily decided based on the minimum safety clearance and electric field exposure of human being beneath the bottom most conductor and at the edge of the ROW at 2 m above the ground level. As per present practice these values are kept 5 kV/m at the edge of RoW and 10 kV/m just below the bottom most conductor, keeping in view the human safety. If construction of buildings is allowed under the existing line, then the land owner would be free to make any unauthorized construction under the line which may endanger the human safety as it would not be possible to stop such construction activities and it may not be possible always to have spans free from mid span joints. The representative of UP was also not in favour of such construction as it would be very difficult to stop such illegal constructions in rural areas. PGCIL was suggested to look in to the possibilities of increasing the height of tower to accommodate such small size houses under the transmission lines.
11. After detailed deliberations on various issues, following was decided:
  - To further explore any other technological options available for reduction of RoW based on worldwide practices and the cost implication.

- PGCIL to provide international practices for addressing the RoW issue in urban / populated / forest areas.
- To explore the possibility of framing detailed guidelines to incorporate RoW consideration at micro planning stage and to explore various options for optimum utilization of the existing RoW as far as possible right at planning stage
- To explore the possibility of dividing the route of transmission line into few broad categories such as normal route, Route through Reserved forest area and Route through Urban areas/Populated area and notifying different RoW for different category suggesting specific technical measures for urban / populated areas / forest areas.

Meeting ended with a vote of thanks to Chair.

Date/time of the meeting: 30.09.2016 at 3.00 pm  
Venue: Ministry of Power, Conference Room  
Shram Shakti Bhawan, New Delhi-110001

Sub: Second meeting of the committee for finalization of compensation in regard to Right of Way (RoW) for transmission line falling in urban areas.

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**List of Participants**

**Ministry of Power**

1. Ms. Shalini Prasad, Additional Secretary - In the chair
2. Smt. Jyoti Arora, Joint Secretary (Trans)
3. Shri Ghanshyam Prasad, Director (Trans)

**Central Electricity Authority (CEA)**

4. Shri K.K. Arya, Chief Engineer (PSPA-I)  
Phone: 26102045/Email: kkarya\_2001@rediffmail.com
5. Shri S.K.RayMohapatra, Chief Engineer  
Mobile: 9818527857/Email: skmohapatra@rediffmail.com
6. Shri Awdhesh Kumar Yadav, Director  
Phone: 26732318/Email: awd.cea@gmail.com
7. Shri Santosh Kumar, Dy. Director  
Email: ksantoshcea@gmail.com
8. Shri Upendra Kumar  
Email: upendra0309@gmail.com

**Power Grid Corporation of India Limited (PGCIL)**

9. Shri R.P.Sasmal, Dir (P&OP)
10. Shri Atul Trivedi, ED  
Mobile: 9873549029/Email: atul.trivedi@powergridindia.com
11. Dr. R.K. Srivastava, AGM (ESMD)  
Mobile: 9910378134/Email: rks@powergridindia.com

**STATE SECTOR**

**Govt. of Karnataka, Bengaluru**

12. Shri P. Ravi Kumar, Addl. Chief Secretary (Energy)  
Phone: 080-22252373/Mobile: 09448124242  
Email: prs-energy@karnataka.gov.in
13. Shri Deepak T.C., Resident engineer  
Email: deepaktc23@gmail.com

**Government of Uttar Pradesh/UPPTCL, Lucknow**

14. Shri Ravi Prakash Dubey, CE (TW)  
Mobile: 09412749801/Email: director\_project@upptcl.org, cetw@upptcl.org
15. Shri Yatendra Kumar, SE (Trans)

**Government of Kerala/KSEBL**

16. Smt. VijayaKumari P., Director (Transmission)  
Mobile: 09446008444/Email: mtkseb@ksebnet.com
17. Ms. Sheela M Daniel, Resident Engineer  
Mobile: 9599096599

**Government of Haryana/HVPNL**

18. Shri Kuldeep Singh, SE/TS Panchkula  
Mobile: 09316369271/Email: setshvnpnkl@gmail.com

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**Minutes of the third meeting of the committee for finalization of compensation in regard to Right of Way (RoW) for transmission line falling in urban areas taken by Ms. Shalini Prasad, Additional Secretary Ministry of Power (MoP) on 2.11.2016**

List of participants is placed at **Annex-I**.

2. Additional Secretary, MoP welcomed the participants and asked Chief Engineer (PSE&TD), CEA to go ahead with the presentation.

3. Chief Engineer (PSE&TD), CEA made a brief presentation (Enclosed at **Annex-II**) apprising the members of the committee about calculations received from PGCIL, M/s Sterlite and Adani. The comparison of reduction in RoW based on reduced span, use of I/V string was presented highlighting that reduction in span can bring down the RoW by about 8-10m at 400kV level and use of V-string can reduce the RoW further. The comparative statement is as follows:

### COMPARISON of CALCULATIONS

S.NO.	Circuit & Conductor	SPAN (m)	Sag (m)	Exist. RoW (m)	RIGHT OF WAY (M)					
					I - STRING			V-STRING		
					Sterlite	PGCIL	Reduction w.r.t exist.	Sterlite	PGCIL	Reduction w.r.t exist.
1	765 kV D/C Zebra	400	13.3	67	66.32	67	NIL	56.41	54	10-13 m
		250	6.10		58.08	58	9 m	48.17	46	19-21 m
2	765 kV S/C Bersimis	400	14.8	64	63.35	64	NIL	54.05	54	10 m
		250	6.8		54.1	55	9 - 10m	44.8	45	9 m
3	400 kV D/C Moose	400	13.3	46	44.01	46	0 - 2 m	37.63	38	8 m
		250	6.1		35.77	38	8-10 m	29.39	30	16 m
4	220 kV D/C Zebra	350	10.6	35	34.41	32	0.5 - 3m			
		200	4.3		27.12	25	8-10 m			
5	132 kV D/c Panther	320	7.8	27	26.31	25	0.5 - 2m			
		200	3.6		21.42	20	5.5 - 7 m			
6	66 kV D/C WOLF	250	5.11	18	18.37		NIL			
		200	3.56		16.59					

Note: The requirement of Electric field at edge of RoW at 2m height needs to be ensured as 5kv/m

4. CE (PSE&TD), CEA informed that the reduction in span would increase the cost of line due to increase in number of towers. For example, the no. of towers per km will increase from 2.5 to 4 per km at 400kV level i.e increase by about 60%. He further suggested that use of V-string insulators may be restricted to areas where RoW constraint is severe.

5. Joint Secretary (Trans), MoP stated that calculation of RoW do not cover use of V-string at 220kV, 132kV and 66kV. The calculation of RoW for above voltage levels with V-string configuration should also be provided by PGCIL.

6. CE(CEI), CEA informed about the request of Himachal Pradesh Electricity Utility and KPTL for reduction of RoW at 33kV and 66kV/132kV level respectively. He also informed that number of cases of death of elephants due to electrocution is a matter of concern for MOEF. He further emphasized the use of covered conductor in such areas. There could be reduction in RoW by about 50% as the required horizontal clearance can be reduced substantially by using covered conductor. CEA is considering the use of conductor at 33kV, 66kV and 132kV level for protecting animals in forest areas and reduction of RoW in Urban areas. He suggested that multiple options for reduction of RoW should be considered and option/ methodology to be used may be left to utilities to decide depending upon the conditions/area/constraints.

7. CE(PSE&TD), CEA highlighted that the current practice of RoW being followed in India for the transmission lines is more or less similar to worldwide practice as per input of PGCIL. Hence, the need for reduction in RoW is essential in urban areas/ populated areas and forest areas and it may not be desirable in areas without constraint. Adoption of available technologies and other methods involving reduction in span, multicircuit/ multicircuit-multivoltage towers, use of insulated cross arm, raising of tower height, use of VSC based HVDC transmission line, and underground cable/ Gas Insulated Lines etc. may be considered in such areas. The reduction in RoW needs to be checked for electric field norms at edge of RoW. PGCIL supplemented that except Korea, where very tall towers are being used at 765kV level to limit RoW to about 37m. The practices of other countries are more or less similar to that of India.

8. Representative from Kerala stated that RoW need not be specified in the regulation because it depends on multiple parameters. It would be preferable to mention the minimum clearance to be maintained instead of the minimum RoW. He further stated that the RoW, presently being used, is based on old tower design and with new technologies/ methodologies available now, it may not be required to maintain same RoW. CE(PSE&TD), CEA stated that it is desirable to define the RoW requirement for each and every voltage level. If voltage wise RoW is not specified then the process will become complex, non-uniform across the country and it will be difficult to calculate compensation.

9. Director (Operations), PGCIL suggested that the construction of single circuit tower should not be allowed anymore and each line may be divided into three/ four sections like approach section near substation, forest area, urban areas/ populated area and areas without constraint.

10. Representative from Maharashtra said that the measurement of RoW from the centre of the tower may be replaced by measurement from the live wire position. Utilities may be given free hand for reduction of the RoW by reduction of span, modifying the tower design, type of tower, and type of conductor etc.



11. Additional Secretary, MoP suggested that a committee comprising of representatives CEA, PGCIL, Kerala and Maharashtra may be constituted to calculate and create a matrix considering all factors influencing the RoW (span, conductor, I/V string, swing angle) for a particular wind zone clearly bringing out the RoW requirements for different combinations. .

12. Joint Secretary (Trans) desired that the state utilities should plan for separate corridor for transmission line for green field projects. Additional Secretary, MoP stated that the matter needs to be discussed with Chief Town planner or other concerned authorities, who are involved in town planning.

13. After detailed deliberations on various issues, following decisions were taken:

13.1 A committee comprising of representatives from CEA, PGCIL, Maharashtra and Kerala will calculate and create matrix for RoW requirements considering all factors influencing the RoW (span, conductor, I/V string, swing angle) for one wind zone, say wind zone 4.

13.2 Chief Town planners or other concerned authorities, who are involved in town planning, would be invited in the next meeting to discuss the provisions of RoW for laying of transmission lines.

13.3 The next meeting to be held in last week of November for reviewing the calculation submitted by the committee.

13.4 The state utilities shall come out with suggestions regarding methodology for calculation of compensation

14. The meeting concluded with thanks to the Chair.

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## **Annex-I**

Date/time of the meeting: 2.11.2016 at 11.30 am  
Venue: Ministry of Power, Conference Room  
Shram Shakti Bhawan, New Delhi-110001

Sub: Third meeting of the committee for finalization of compensation in regard to Right of Way (RoW) for transmission line falling in urban areas.

### **List of Participants**

#### **Ministry of Power**

1. Ms. Shalini Prasad, Additional Secretary - In the chair
2. Smt. Jyoti Arora, Joint Secretary (Trans)
3. Shri Ghanshyam Prasad, Director (Trans)

#### **Central Electricity Authority (CEA)**

4. Shri Goutam Roy, Chief Electrical Inspector  
Phone: 8376817933/Email: goutamroy.715@gmail.com
5. Shri S.K.RayMohapatra, Chief Engineer  
Mobile: 9818527857/Email: skmohapatra@rediffmail.com
6. Shri Awdhesh Kumar Yadav, Director  
Phone: 26732318/Email: awd.cea@gmail.com
7. Shri Upendra Kumar  
Email: upendra0309@gmail.com

#### **Power Grid Corporation of India Limited (PGCIL)**

8. Shri R.P.Sasmal, Dir (P&OP)
9. Shri AK Vyas, AGM  
Mobile: 9910378107/Email: akvyas@powergridindia.com

#### **STATE SECTOR**

##### **Govt. of Karnataka/ KPTCL**

10. Shri Deepak T.C., Resident engineer  
Email: deepaktc23@gmail.com

##### **Government of Uttar Pradesh/UPPTCL, Lucknow**

11. Shri Ravi Prakash Dubey, CE (TW)  
Mobile: 09412749801/Email: director\_project@upptcl.org, cetw@upptcl.org
12. Shri Yatendra Kumar, SE (Trans)  
Mobile No: 8130599601

##### **Government of Kerala/KSEBL**

13. Shri P. Rajan, Chief Engineer  
Mobile: 9496012377

##### **Government of Haryana/HVPNL**

14. Shri MK Vats, SE- Faridabad  
Mobile: 9313472674/ Email: setsfbd@rediffmail.com@gmail.com, setsfbd@hvpn.org.in, setsfbd@hvpn.gov.in

##### **Govt. of Maharashtra/ MSETCL**

15. Shri SV Gaherwar, SE (Corp. Office)  
Mobile: 9920589797  
Email: se4prj@mahatransco.in

## **Annex-II**



CEA PPT.pptx

**Minutes of the 4<sup>th</sup> meeting of the Committee chaired by Ms. Shalini Prasad, Additional Secretary, Ministry of Power (MoP) on 08-12-2016 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 Chief Engineer (PSP&PA-I), CEA highlighted about the discussions held with PGCIL and KSEB on 25.11.2016 and asked CE (PSE&TD) to make a brief presentation.

3. Chief Engineer (PSE&TD), CEA made a brief presentation (Enclosed as **Annex-2**) apprising the members of the committee about calculations. He informed that as decided in the last meeting, based on the inputs from PGCIL and Kerala, matrix for RoW width has been prepared considering various factors influencing the RoW (span, conductor, I/V string, swing angle) for wind Zone 4. As discussed in last meeting, it was proposed to divide the route of transmission lines (66kV and above voltage level) into three sections/ categories namely Normal route without constraint, Forest area and Urban area/populated areas/ approach section near substation. He further informed that the RoW matrix provides the values for following two conditions:

- (i) Specifying RoW and base width of tower for different voltage level for calculation of compensation
- (ii) Specifying the safety clearance requirement including swing of conductor and giving opportunity for optimizing the design of tower.

4. The representative from Karnataka stated that if the compensation is to be provided for the maximum value of RoW, then there will be no incentive for the utilities to optimise design of tower requiring lesser RoW or use better conductors to reduce the RoW. He argued that compensation should be provided for the actual RoW of transmission line. CE(PSE&TD), CEA informed that it is not desirable to calculate RoW requirement based on individual span for the purpose of compensation payment as it will be extremely difficult and practically impossible to calculate compensation on case to case basis. The process will be very complex, non-uniform across the country and it may lead to increase in legal disputes.

5. CE(PSP&PA-I), CEA stated that a number of times, representations have been received from Small Hydro Power developers for the reduction of RoW at 33 kV level. He also informed that number of cases of death of elephants in forest areas due to electrocution has been reported and it has become a matter of

concern for M/o Environment & Forests. The use of covered conductor, pole type structure etc. in forest areas need to be studied. He proposed to extend the scope of the work for finalizing the RoW requirement for 33kV system for which a small committee may be constituted.

6. Director (O), PGCIL suggested to mandate the use of only multi circuit and multi voltage towers in the approach section of the substations upto a certain distance to reduce the RoW requirement. Director (PSP&PA-I), CEA added that length of this approach section depends upon the location of substation, which depends on many factors like availability of land, cost of land and expected load etc. He also pointed out that the onus is on the state utilities to connect ISTS to their load centres, but the location of substation (under ISTS) is generally identified by the developer/transmission utilities. Director(O), PGCIL said that generally the location of EHV substations are away from the cities and the use of multi circuit/ multi-circuit & multi voltage towers at the approach section of the substations should be mandated. CE(PSE&TD), CEA informed that the provision has been made in the draft CEA (Technical Standard for construction of Electric Plants & Electric Line) Regulations.

7. Chairperson enquired about the methodologies being followed by state utilities to calculate the compensation to be paid to the owner of the land/ affected party and whether the annuity based method is more suitable than the current practice of onetime compensation payment. Representative from Kerala informed that they are providing annuity in both urban as well as rural areas. Representative from Karnataka said that they are providing 100% compensation for land use for tower footing and 75% of land cost for RoW value in urban areas and 50 % of land cost of RoW in rural areas. Joint Secretary (Trans), MoP said that the provision of 85% of compensation for the tower footing was kept with intention that 100 % compensation is equivalent to acquisition of the land. Representative from Haryana stated that when the number of line crossing increases, the land owners do not like to spare their land even after offering the compensation. Representative from Kerala stated that annuity based compensation is preferred as it provides a source of regular income to the owner and the land has some resale value. Joint Secretary, MoP said that a choice can be given to the owner to choose between an annuity based compensation or onetime payment of compensation amount.

8. Joint secretary (Trans), MoP stated that the land under the transmission lines is used by owners for cultivation/ other activities in the rural areas and this is not possible in the urban areas. It is better to use monopole structure in the urban areas. This will reduce the footprint and land requirement. Director(O), PGCIL, informed that use of monopole may increase the cost of the line by about 20% as the pole type towers are three times costlier than the lattice towers. But, it will

reduce the compensation cost. Joint Secretary (Trans), MoP stated that pole type towers should be made mandatory for transmission lines up to 400 kV in the urban areas. Chief Engineer(PSE&TD), CEA highlighted that it is difficult to transport & erect monopole structure in densely populated areas/ urban areas as in many cases the approach to site may not be accessible, difficult to transport heavy structural parts of pole and to use heavy cranes for erection of poles. Representative from Kerala also agreed with his view and informed that KSEB is facing similar difficulties in using the pole structure in urban areas, although the requirement of monopole structure is maximum in such areas.

9. Chairperson said that demand for compensation will reduce if the owners are allowed to perform their activities below the transmission lines. As in Japan, towers with sufficiently increased heights can be used to allow the land owners to use their land. In such cases, the amount of compensation to be paid can be determined vis-a-vis the activities allowed under the transmission line.

10. Joint secretary (Trans), MoP said that for Greenfield projects, clear demarcation of RoW should be done. Additional Secretary, MoP added that while planning a new transmission line, in place of shortest route, a more optimised route should be chosen avoiding the possible hindrances in land acquisition for example new line should be planned along the rail corridor, road etc., if feasible.

11. After detailed deliberations on various issues, following decisions were taken:

- (i) A sub-committee comprising of representatives from CEA, Punjab, Uttarakhand, Himachal Pradesh and TATA Power and few others would deliberate and finalise RoW requirements for 33 kV transmission lines.
- (ii) Deliberations to be held with Chief Town planners or other concerned authority, who are involved in town planning, to discuss about dedicated corridor for laying of transmission lines for Greenfield projects.
- (iii) CEA to consider framing of guidelines stipulating use of monopole structure / multi-circuit / multi-circuit & multi-voltage towers in urban areas and in approach section near substation. The use of such structures can be considered by Utilities for other areas based on economics.
- (iv) CEA and PGCIL to prepare a Draft Report concluding the decisions taken by the Committee.
- (v) The issue regarding compensation methodology would be discussed further by MoP with state utilities.

12. The meeting concluded with thanks to the Chair.

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Date/time of the meeting: 8.12.2016 at 3.00 pm  
Venue: Ministry of Power, Conference Room  
Shram Shakti Bhawan, New Delhi-110001

**Subject:** 4<sup>th</sup> meeting for finalization of compensation in regard to ROW for transmission lines in urban areas.

**List of Participants**

**Ministry of Power**

1. Ms. Shalini Prasad, Additional Secretary (SP) - In the Chair
2. Smt. Jyoti Arora, Joint Secretary (Trans)
3. Shri Bihari Lal, Under Secretary (Trans)

**Central Electricity Authority (CEA)**

4. Shri K.K. Arya, Chief Engineer (PSPA-I)  
Phone : 011-26102045/Email : kkarya\_2001@rediffmail.com
5. Shri Awadesh Yadav, Director (PSPA-I)  
Phone : 011-26732318/Mob:9868664087/Email : awd.cea@gmail.com
6. Shri Mohit Mudgal, Assistant Director-I  
Phone:011-26732352/Mob:9873454092/Email: mohitmudgal20@gmail.com
7. Shri Priyam Srivastava, Assistant Director-I  
Phone : 26732337/Mob:9717650473/Email: priyam.cea@gmail.com

**Power Grid Corporation of India Limited (PGCIL)**

8. Shri R P Samsal, Director (Projects),  
Mobile: 9810532802/Email: rpsasmal@powergridindia.com
9. Shri A.K.Vyas, Addl. GM  
Mobile: 9910378107/Email: akvyas@powergridindia.com

**Govt. of Haryana/Haryana VidyutPrasaran Nigam Limited (HVPNL)**

10. Shri M.K. Vats, Superintending Engineer,  
Mobile: 9313472674, Email: setsfbd@hvpn.org.in,setsfbd@hvpn.gov.in

**Uttar Pradesh Power Transmission Corporation Ltd. (UPPTCL)**

11. Shri R.P.Dubey, CE,  
Mobile: 9412749801/Email: director\_project@upptcl.org,cetw@upptcl.org
12. Shri Yatendra Kumar, Superintending Engineer(Trans),  
Mobile: 7290059601, Email: director\_project@upptcl.org

**Karnataka Power Transmission Corporation Ltd. (KPTCL)**

13. Shri P. Ravi Kumar, Secretary (Energy),  
Mobile: 9448124242/Email: prs-energy@karnataka.gov.in
14. Shri Deepak T.C., Resident Engineer,  
Mobile: 9717695294/Email: deepaktc23@gmail.com

**Kerala State Electricity Board Limited (KSEB)**

15. Smt. Vijaya Kumari P., Director (Tr&SO)  
Mobile: 9446008444/Email: mtkseb@ksebnet.com

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Annex-2



4th RoW ppt.rar

**Minutes of the 5<sup>th</sup> 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.

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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.  
Mobile: 7290059601, Email: director\_project@upptcl.org

**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

**TCPO, MOUD**

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

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

**5. 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 15<sup>th</sup> 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 4<sup>th</sup> 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.

**6. 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 1<sup>st</sup> 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 1<sup>st</sup> meeting is enclosed at **Annexure-II**.

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 2<sup>nd</sup> 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 2<sup>nd</sup> 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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No. 3/4/2016-Trans  
Government of India  
Ministry of Power  
Shram Shakti Bhawan, Rafi Marg, New Delhi- 110001

Dated, 20<sup>th</sup> 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 the Chairpersonship 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.

(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 MD, Tata Power, Mumbai



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

Dated, 13<sup>th</sup> 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.

(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

**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 4<sup>th</sup> 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 need 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 to 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**

<b>Sl. No.</b>	<b>Name Shri/Smt</b>	<b>Designation</b>
<b>I. CEA</b>		
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
<b>II. Tata Power Delhi</b>		
12.	H.C. Sharma	- Head (Project)
<b>III. PSPCL</b>		
13.	Sanjeev Gupta	- Dy CETL(Dsg.)
<b>IV. HPSEBL</b>		
14.	R.K. Sharma	- Director
<b>V. Uttarakhand Power Corporation Limited (UPCL)</b>		
15.	Er. P.C. Pandey	- Chief Engineer
<b>VII. Himalaya Power Producers Association</b>		
16.	Pawan Kohli	-President
17.	Er. C.J. Rai	- Chief Engineer

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)			
								$H=(E+F) \sin 35$	$H=(E+F) \sin 60$					
B														
C														
D														
E														
F														
X														
$R=2(D+H)+2X$														
ACSR DOG		Lattice type/ Steel Monopole	250	"I" String/Suspension	2.0	0								
				Tension	2.0									
				"I" String/Suspension	2.0									
				Tension	2.0									
				( 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	0								
				Tension	2.0									
				"I" String/Suspension	2.0									
				Tension	2.0									
				( Concrete Pole/Rail pole/H pole/ Single steel pole)	100	Pin Insulator	2.0	0						
					60	Pin Insulator	2.0	0						

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

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

**Minutes of the 2<sup>nd</sup> 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 1<sup>st</sup> 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	
	(Concrete Pole/Rail pole/H pole/ Single steel pole)	150	"I" String/Suspension	12 meter
			Tension	
	(Concrete Pole/Rail pole/H pole/ Single steel pole)	100	Pin Insulator	9 meter
			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**

<b>Sl. No.</b>	<b>Name Shri/Smt</b>	<b>Designation</b>
<b>I. CEA</b>		
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
<b>II. HPPA , SHIMLA</b>		
14.	Powan Koli	-Vice President
15.	C.J. Rai	-Secy. General
<b>III. HPSEB Ltd. , Hamirpur</b>		
16.	Lukesh Kumar	- Sr. Executive Engineer
17.	Pritam Chand	- SE (Design)
<b>IV. TPDDL</b>		
18.	Kapil Kumar	- AGM (PE)
<b>V. Uttarakhand Power Corp.</b>		
19.	P.C. Pandey	- Chief Engineer

Table 1

Conductor type	Configuration	Insulator type (Lattice type/ Concrete pole/Steel tower/Full pole/Full tower/Single steel pole)	Span (m)	Sling type	Horizontal clearance (m)	Insulator length (Conventional for Sling) (m)	Max Sag at 60°C (m)	Max Sling angle in Sag	Horizontal Attachment from Conductor attachment points (m)		Maximum horizontal distance of Conductor attachment point from centre of tower (m)	Width of right of way (m)			Width of right of way (m) (with 17° sag)	Width of right of way (m) (with 67° sag)	Upper Width of right of way (m)	Lower Width of right of way (m)	Clearance from ground (m)	SF		Electric field with Delta Configuration (kV/m)		
									W1 (m)	W2 (m)		W3 (m)	At edge of ROW	At 5.5 m from insulator										
A23 330	Lattice tower/Steel towers	150	17° Sling/ Suspension	2.0	0.75	4.61	5.85	5.50	3.30	25.75	13.25	08	14.80	10.41	11.28	16.10/14.00**	0.19	0.38	0.91					
			Tension	2.0	0	4.61	5.11	4.48	3.30	13.71	10.61	08	14.80	10.11	10.68	15.80/14.00**	0.19	0.38	1.01					
		150	17° Sling/ Suspension	2.0	0.75	2.61	1.96	1.61	3.30	6.88	7.88	08	11.28	10.24	10.94	14.20/12.50**	0.27	0.38	1.30					
			Tension	2.0	0	2.61	1.70	1.28	3.30	6.08	7.10	08	11.41	10.98	1.48	14.00/12.50**	0.27	0.38	1.29					
	Horizontal	150	No insulator	2.0	0	1.00	0.86	1.00	1.01	6.60	5.71	08	6.60	5.70	6.60/5.61	6.36	6.71	6.60	6.36					
			60	No insulator	2.0	0	0.77	0.68	0.68	1.01	5.93	4.88	08	7.08	6.61	6.60/5.61	6.02	7.00	6.36	6.36				
		150	No insulator	2.0	0	1.00	0.86	1.00	0.70	6.60	5.71	08	7.10	6.61	6.60/5.61	6.36	7.10							
			60	No insulator	2.0	0	0.77	0.68	0.68	0.70	5.93	4.88	08	6.61	6.60/5.61	6.02	6.60							
	Delta	150	No insulator	2.0	0	1.00	0.86	1.00	0.70	6.60	5.71	08	7.10	6.61	6.60/5.61	6.36	7.10							
			60	No insulator	2.0	0	0.77	0.68	0.68	0.70	5.93	4.88	08	6.61	6.60/5.61	6.02	6.60							
		150	No insulator	2.0	0	1.00	0.86	1.00	0.70	6.60	5.71	08	7.10	6.61	6.60/5.61	6.36	7.10							
			60	No insulator	2.0	0	0.77	0.68	0.68	0.70	5.93	4.88	08	6.61	6.60/5.61	6.02	6.60							
A23 345	Lattice tower/Steel towers	150	17° Sling/ Suspension	2.0	0.75	4.96	5.17	4.96	3.30	26.88	13.01	08	14.81	10.42	11.69	16.10/14.00**	0.19	0.38	1.19					
			Tension	2.0	0	4.96	4.68	4.30	3.30	12.70	10.11	08	14.80	10.36	10.61	15.80/14.00**	0.19	0.38	1.22					
		150	17° Sling/ Suspension	2.0	0.75	2.93	1.70	1.63	3.30	6.92	7.84	08	11.88	10.60	10.28	14.07/12.50**	0.28	0.38	1.03					
			Tension	2.0	0	2.93	1.28	1.08	3.30	7.80	6.88	08	10.88	11.07	6.78	13.80/12.50**	0.28	0.38	1.03					
	Horizontal	150	No insulator	2.0	0	1.00	0.75	1.07	1.01	6.13	5.61	08	6.13	5.61	6.60/5.61	6.36	6.13	6.36	6.36					
			60	No insulator	2.0	0	0.78	0.63	0.63	1.01	5.68	4.68	08	7.10	6.61	6.77	6.3	7.03	6.36	6.36				
		150	No insulator	2.0	0	1.00	0.75	1.07	0.70	6.13	5.61	08	6.67	7.03	6.60/5.61	6.36	6.67							
			60	No insulator	2.0	0	0.78	0.63	0.70	0.70	5.68	4.68	08	6.13	6.60	6.77	6.3	6.13						
	Delta	150	No insulator	2.0	0	1.00	0.75	1.07	0.70	6.13	5.61	08	6.67	7.03	6.60/5.61	6.36	6.67							
			60	No insulator	2.0	0	0.78	0.63	0.70	0.70	5.68	4.68	08	6.13	6.60	6.77	6.3	6.13						
		150	No insulator	2.0	0	1.00	0.75	1.07	0.70	6.13	5.61	08	6.67	7.03	6.60/5.61	6.36	6.67							
			60	No insulator	2.0	0	0.78	0.63	0.70	0.70	5.68	4.68	08	6.13	6.60	6.77	6.3	6.13						

\*\* Higher values indicated using value of 10kV/22.5kV. Lower values indicated using value of 10kV/30kV

### **Minutes of the 6<sup>th</sup> 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

Date/ time of the meeting: 9.5.2017 at 3 pm  
Venue: Ministry of Power, Conference Room  
Shram Shakti Bhawan, New Delhi-110001

**List of Participants**

**Ministry of Power**

1. Ms. Shalini Prasad, Additional Secretary (SP) In the Chair
2. Shri Irfan Ahmad, Director (Trans)

**Ministry of Urban Development**

3. Shri Mohd. Monis Khan, Town & Country Planner,  
Mobile: 9818158485, Telefax: 011-23370620, Email: khanmonis@gmail.com

**Central Electricity Authority (CEA)**

4. Shri Ravinder Gupta, Chief Engineer,  
Mobile: 9968286184, Email: ravindergupta\_cea@rediffmail.com
5. Shri S.K. Ray Mohapatra, Chief Engineer,  
Mobile: 9818527857, Email: skmohapatra@rediffmail.com
6. Shri Awadesh Yadav, Director (PSPA-I)  
Phone: 011-26732318/Mob: 9868664087/Email: awd\_cea@gmail.com
7. Shri Upendra Kumar, Director CEI,  
Mobile: 9910180485, Telefax: 011-26510249, Email: upendra0309@gmail.com
8. Shri M. Srikanth Reddy, Assistant Director,  
Mobile: 8447272084, Email: adptcl@gmail.com
9. Shri P.K. Sangwan, Assistant Director,  
Mobile: 9560741071, Telefax: 011-26732711, Email: pksangwan@nic.in

**Power Grid Corporation Of India Limited (PGCIL)**

10. Shri A. K. Sinha, ED,  
Mobile: 9425293910, 0124-2571980, Email: ak\_sinha@powergridindia.com
11. Shri A.K. Vyas, Addl. GM,  
Mobile: 9910378107, Email: akvyas@powergridindia.com

**Govt. of Haryana/ HVPNL**

12. Shri Gulshan Nagpal, SE,  
Mobile: 9313472660, Email: setsfbd@rediffmail.com

**Govt. of Uttar Pradesh/ UPPTCL**

13. Shri Yatendra Kumar, SE (T), Ghaziabad,  
Mobile: 7290059601, Email: cetw@upptcl.org
14. Shri Mohd Ishaq, SE,  
Mobile: 7290059601, Email: seetegn@gmail.com

**Govt. of Karnataka**

15. Shri A.K. Tiwari, Resident Commissioner,  
Mobile: 9868393900, Email: rckarnatakanevdelhi@gmail.com

**Govt. of Kerala/ KSEBL**

16. Smt. Vijayakumari, P. Director,  
Mobile: 9446008444, Email: mtksebl@kseblnet.com
17. Smt. Sheela M Daniel, Resident Engineer,  
Mobile: 9599096599, 011-23381964, Email: ksebl Delhi@gmail.com

**Govt. of Maharashtra/ MAHATRANSCO**

18. Shri Yogesh Pach Pande, SE (Maha Transco),  
Mobile: 9920103000, Telefax: 022-26595265, Email: yogeshpachpande@gmail.com

## Appendix X

13 MAY 2014  
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F. No. 7-25/2012-FC  
Government of India  
Ministry of Environment and Forests  
(FC Division)

Paryavaran Bhawan,  
CGO Complex, Lodhi Road,  
New Delhi - 110 510  
Dated: 5<sup>th</sup> May, 2014

To

**The Principal Secretary (Forests),**  
All State / Union Territory Governments

**Sub:** Guidelines for diversion of forest land for non-forest purposes under the Forest (Conservation) Act, 1980- Guidelines for laying transmission lines through forest areas - reg.

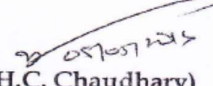
Sir,

I am directed to say that the Hon'ble National Green Tribunal in their Order dated 7<sup>th</sup> March 2012 in the Appeal No. 10 of 2012 in the matter of Janajagaritii Samiti (Regd.) versus Union of India and Others directed this Ministry to take steps and notify the detailed fresh guidelines for laying transmission lines through forest area, incorporating necessary changes to mitigate the difficulties which arise during granting forest clearance.

Accordingly, this Ministry in consultation with the Central Electricity Authority formulated revised guidelines for laying transmission lines through forest areas. **A copy of the same is enclosed.**

*Encl.:* As above.

Yours faithfully,

  
(H.C. Chaudhary)

Assistant Inspector General of Forests

**Copy along with a copy of the said guidelines to:-**

1. Prime Minister's Office (*Kind attn.:* Shri Santosh D. Vaidya, Director).
2. Secretary, Ministry of Power, Government of India, Shram Shakti Bhawan, New Delhi.
3. Principal Chief Conservator of Forests, all State/UT Governments.
4. Nodal Officer, the Forest (Conservation) Act, 1980, all State/UT Governments.
5. All Regional Offices, Ministry of Environment & Forests (MoEF), Government of India (GoI).
6. Joint Secretary in-charge, Impact Assessment Division, MoEF, GoI
7. All Assistant Inspector General of Forests/ Director in the Forest Conservation Division, MoEF, GoI.

## GUIDELINES FOR LAYING TRANSMISSION LINES THROUGH FOREST AREAS

1. Where routing of transmission lines through the forest areas cannot be avoided, these should be aligned in such a way that it involves the least amount of tree cutting
2. As far as possible, the route alignment through forest areas should not have any line deviation.
3. (i) The width of right of way for the transmission lines on forest land shall be as follows:

Transmission Voltage	Width of Right of Way (Meter)
11kV	7
33 kV	15
66 kV	18
110 kV	22
132 kV	27
220 kV	35
400 kV S/C	46
400 kV D/C	46
+/- 500 kV HVDC	52
765 kV S/C (with delta configuration)	64
765 kV D/C	67
+/- 800 kV HVDC	69
1200 kV	89

- (ii) In forest areas, only vertical delta configuration of 400 kV S/C and delta configuration of 765 kV S/C shall be permitted.
4. (i) Below each conductor or conductor bundle, following width clearance would be permitted for stringing purpose:

Transmission line with conductor bundle	Width clearance below each conductor or conductor bundle (meter)
Upto 400kV twin bundle	3

400 kV triple bundle	5
400 kV / +/- 500 kV HVDC / 765 kV Quadruple bundle	7
+/- 800 kV HVDC / 765 kV hexagonal bundle	10

- (ii) The trees on such strips would have to be felled but after stringing work is completed, natural regeneration will be allowed to come up. Felling/ pollarding/ pruning of trees will be done with the permission of the local forest officer wherever necessary to maintain the electrical clearance. One outer strip shall be left clear to permit maintenance of the transmission line.
- (iii) During construction of transmission line, pollarding/ pruning of trees located outside the above width of the strips, whose branches/ parts infringe with conductor stringing, shall be permitted to the extent necessary, as may be decided by local forest officer.
- (iv) Pruning of trees for taking construction/stringing equipments through existing approach/access routes in forest areas shall also be permitted to the extent necessary, as may be decided by local forest officer. Construction of new approach/access route will however, require prior approval under the Act..
- (v) In the remaining width of right of way trees will be felled or lopped to the extent required, for preventing electrical hazards by maintaining the following:

Transmission Voltage	Minimum clearance between conductor and trees (Meters)
11 kV	2.6
33 kV	2.8
66 kV	3.4
110 kV	3.7
132 kV	4.0
220 kV	4.6
400 kV	5.5
+/- 500 kV HVDC	7.4
765 kV	9.0
+/- 800 kV HVDC	10.6
1200 kV	13.0

- (vi) The maximum sag and swing of the conductors are to be kept in view while

working out the minimum clearance mentioned as above.

- (vii) To avoid any hazard, felling/cutting/pruning of those trees which because of their height /location may fall on conductors shall also be permitted, as may be decided by local forest office.
  - (viii) In the case of transmission lines to be constructed in hilly areas, where adequate clearance is already available, trees will not be cut except those minimum required to be cut for stringing of conductors.
  - (ix) In case of transmission lines passing through National Parks, Wildlife Sanctuaries and Wildlife Corridors, insulated conductors shall only be used to prevent electrocution of animals.
5. Where the forest growth consists of coconut groves or similar tall trees, widths of right of way greater than those indicated at Sl. No.3 may be permitted in consultation with CEA.

\*\*\*\*\*



TABLE-2

**RIGHT OF WAY CALCULATION FOR NORMAL ROUTE, FOREST AREA, URBAN AREA / POPULATED AREA /  
APPROACH SECTION NEAR SUBSTATION**

Voltage level (kV)	Configuration	Conductor type	Terrain	Design Span (in m)	String Type	Horizontal clearance (in m) (2.0m+0.3 M for every additional 33 kV or part thereof (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)	Width of right of way (in m)	Maximum Horizontal distance of Conductor attachment point from centre of tower (in m)	Approx. Width of right of way (in m)	Electric field at edge of ROW (in kV/m)
A		B		C		D	E	F	$H=(E+F)*\sin 35$	$R=2(D+H)+2X$	X	R	
765kV D/C	Vertical	ACSR ZEBRA	Normal Route	400	"I" String	9.0	7.6	13.3	12.0	<b>42+2X</b>	12.5	<b>67</b>	1.9
					"V" String	9.0	0	13.3	7.6	<b>33.2+2X</b>	10.5	<b>54</b>	2.7
					Tension	9.0	0	13.3	7.6	<b>33.2+2X</b>	14.5	<b>62</b>	
			Forest	300	"I" String	9.0	7.6	8.2	9.1	<b>36+2X</b>	12.5	<b>61</b>	2.9
					"V" String	9.0	0	8.2	4.7	<b>27+2X</b>	10.5	<b>48</b>	3.7

					Tension	9.0	0	8.2	4.7	<b>27+2X</b>	14.5	<b>56</b>			
			Urban area / populated area / approach section near substation	250	"I" String	9.0	7.6	6.1	7.9	<b>34+2X</b>	12.5	<b>59</b>	3.2		
					"V" String	9.0	0	6.1	3.5	<b>25+2X</b>	10.5	<b>46</b>	4.2		
					Tension	9.0	0	6.1	3.5	<b>25+2X</b>	14.5	<b>54</b>			
765kV S/C	Vertical /Delta	ACSR BERSIMIS	Plain	400	"I" String	9.0	7.1	14.8	12.6	<b>43.2+2X</b>	10.5	<b>64</b>	2.5		
					"V" String	9.0	0	14.8	8.5	<b>35+2X</b>	9.5	<b>54</b>	3.2		
					Tension	9.0	0	14.8	8.5	<b>35+2X</b>	13	<b>61</b>			
			Forest	300	"I" String	9.0	7.1	9.1	9.3	<b>36.6+2X</b>	10.5	<b>58</b>	3		
					"V" String	9.0	0	9.1	5.2	<b>28.4+2X</b>	9.5	<b>47</b>	4.1		
					Tension	9.0	0	9.1	5.2	<b>28.4+2X</b>	13	<b>54</b>			
			Urban	250	"I" String	9.0	7.1	6.8	8.0	<b>34+2X</b>	10.5	<b>55</b>	3.3		
"V" String	9.0	0			6.8	3.9	<b>25.8+2X</b>	9.5	<b>45</b>	4.5					

					Tension	9.0	0	6.8	3.9	<b>25.8+2X</b>	13	<b>52</b>	

765kV S/C	Horizontal	ACSR BERSIMIS	Plain	400	"I" String	9.0	7.1	14.8	12.6	<b>43.2+2X</b>	15.6	<b>74</b>	3			
					"V" String	9.0	0	14.8	8.5	<b>35+2X</b>	14.4	<b>64</b>	3.9			
					Tension	9.0	0	14.8	8.5	<b>35+2X</b>	18.2	<b>71</b>				
			Forest	300	"I" String	9.0	7.1	9.1	9.3	<b>36.6+2X</b>	15.6	<b>68</b>	3.8			
					"V" String	9.0	0	9.1	5.2	<b>28.4+2X</b>	14.4	<b>57</b>	5.1			
					Tension	9.0	0	9.1	5.2	<b>28.4+2X</b>	18.2	<b>65</b>				
			Urban	250	"I" String	9.0	7.1	6.8	8.0	<b>34+2X</b>	15.6	<b>65</b>	4.2			
					"V" String	9.0	0	6.8	3.9	<b>25.8+2X</b>	14.4	<b>55</b>	<b>5.5</b>			
					Tension	9.0	0	6.8	3.9	<b>25.8+2X</b>	18.2	<b>62</b>				
			±800kV HVDC	Horizontal	ACSR Lapwing	Plain/Forest/ Urban	400	"Y" String	10.6	5.3	14.9	11.6	<b>44.4+2X</b>	12.3	69	5.1
			±500kV HVDC	Horizontal	ACSR Lapwing	Plain/Forest/ Urban	400	"V" String	7.4	0	14.9	8.5	<b>31.8+2X</b>	8.2	48	4.9
			400kV D/C & S/C	Vertical	ACSR MOOSE	Plain	400	"I" String	5.6	4.0	13.3	9.9	<b>31+2X</b>	7.5	<b>46</b>	0.8
"V" String	5.6	0						13.3	7.6	<b>26.4+2X</b>	6.0	<b>38</b>	1.1			
Tension	5.6	0						13.3	7.6	<b>26.4+2X</b>	9.7	<b>46</b>				
Forest	300	"I" String				5.6	4.0	8.2	7.0	<b>25.2+2X</b>	7.5	<b>40</b>	1.5			

					"V" String	5.6	0	8.2	4.7	<b>20.6+2X</b>	6.0	<b>33</b>	1.7		
					Tension	5.6	0	8.2	4.7	<b>20.6+2X</b>	9.7	<b>40</b>			
			Urban	250	"I" String	5.6	4.0	6.1	5.8	<b>22.8+2X</b>	7.5	<b>38</b>	1.9		
					"V" String	5.6	0	6.1	3.5	<b>18.2+2X</b>	6.0	<b>30</b>	2.3		
					Tension	5.6	0	6.1	3.5	<b>18.2+2X</b>	9.7	<b>38</b>			
400kV S/C	Horizontal	ACSR MOOSE	Plain	400	"I" String	5.6	4.0	13.3	9.9	<b>31+2X</b>	10.9	<b>53</b>	2.3		
					"V" String	5.6	0	13.3	7.6	<b>26.4+2X</b>	9.1	<b>45</b>	2.8		
					Tension	5.6	0	13.3	7.6	<b>26.4+2X</b>	13.5	<b>53</b>			
			Forest	300	"I" String	5.6	4.0	8.2	7.0	<b>25.2+2X</b>	10.9	<b>47</b>	3.2		
					"V" String	5.6	0	8.2	4.7	<b>20.6+2X</b>	9.1	<b>39</b>	4.6		
					Tension	5.6	0	8.2	4.7	<b>20.6+2X</b>	13.5	<b>48</b>			
			Urban	250	"I" String	5.6	4.0	6.1	5.8	<b>22.8+2X</b>	10.9	<b>45</b>	3.6		
"V" String	5.6	0			6.1	3.5	<b>18.2+2X</b>	9.1	<b>36</b>	4.8					
Tension	5.6	0			6.1	3.5	<b>18.2+2X</b>	13.5	<b>45</b>						
1200kV	Horizontal	ACSR Moose	Plain/Forest/ Urban	400	"V" String	13.0	0	13.3	7.6	<b>41.2+2X</b>	24	<b>89</b>	5.3		
220kV D/C	Vertical	ACSR ZEBRA	Plain	350	"I" String	3.8	2.5	10.6	7.5	<b>22.6+2X</b>	4.6	<b>32</b>	0.4		
					"V" String	3.8	0	10.6	6.1	<b>19.8+2X</b>	4	<b>28</b>			
					Tension	3.8	0	10.6	6.1	<b>19.8+2X</b>	5.7	<b>31</b>			
			Forest	300	"I" String	3.8	2.5	8.2	6.1	<b>19.8+2X</b>	4.6	<b>29</b>			
"V" String	3.8	0			8.2	4.7	<b>17+2X</b>	4	<b>25</b>						

					Tension	3.8	0	8.2	4.7	<b>17+2X</b>	5.7	<b>28</b>	
			Urban	200	"I" String	3.8	2.5	4.3	3.9	<b>15.4+2X</b>	4.6	<b>25</b>	1.1
					"V" String	3.8	0	4.3	2.5	<b>12.6+2X</b>	4	<b>21</b>	
					Tension	3.8	0	4.3	2.5	<b>12.6+2X</b>	5.7	<b>24</b>	
132kV D/C / 110 kV D/C	Vertical	ACSR PANTHER	Plain	320	"I" String	2.9	2.3	7.5	5.6	<b>17+2X</b>	3.9	<b>25</b>	0.5
					"V" String	2.9	0	7.5	4.3	<b>14.4+2X</b>	3.5	<b>21</b>	
					Tension	2.9	0	7.5	4.3	<b>14.4+2X</b>	5.3	<b>25</b>	
			Forest	200	"I" String	2.9	2.3	3.6	3.4	<b>12.6+2X</b>	3.9	<b>20</b>	
					"V" String	2.9	0	3.6	2.1	<b>10+2X</b>	3.5	<b>17</b>	
					Tension	2.9	0	3.6	2.1	<b>10+2X</b>	5.3	<b>21</b>	
			Urban	150	"I" String	2.9	2.3	2.3	2.6	<b>11+2X</b>	3.9	<b>19</b>	0.9
					"V" String	2.9	0	2.3	1.3	<b>8.4+2X</b>	3.5	<b>15</b>	
					Tension	2.9	0	2.3	1.3	<b>8.4+2X</b>	5.3	<b>19</b>	

66kV	Vertical	ACSR PANTHER	Plain	250	"I" String	2.3	1.9	5.0	4.0	<b>12.5+2X</b>	2.5	<b>18</b>	
					"V" String	2.3	0	5.0	2.9	<b>10.4+2X</b>	2.5	<b>15</b>	
					Tension	2.3	0	5.0	2.9	<b>10.4+2X</b>	3.5	<b>17</b>	
			Forest	150	"I" String	2.3	1.9	2.3	2.4	<b>9.4+2X</b>	2.5	<b>14</b>	
					"V" String	2.3	0	2.3	1.3	<b>7.3+2X</b>	2.5	<b>12</b>	
					Tension	2.3	0	2.3	1.3	<b>7.3+2X</b>	3.5	<b>14</b>	
			Urban	100	"I" String	2.3	1.9	1.3	1.8	<b>8.3+2X</b>	2.5	<b>13</b>	
					"V" String	2.3	0	1.3	0.7	<b>6.1+2X</b>	2.5	<b>11</b>	

					Tension	2.3	0	1.3	0.7	<b>6.1+2X</b>	3.5	13
66kV	ACSR DOG	Plain	250	"I" String	2.3	1.9	6.3	4.7	<b>14+2X</b>	2.5	19	
				"V" String	2.3	0	6.3	3.6	<b>11.8+2X</b>	2.5	17	
				Tension	2.3	0	6.3	3.6	<b>11.8+2X</b>	3.5	19	
		Forest	150	"I" String	2.3	1.9	2.9	2.8	<b>10.2+2X</b>	2.5	15	
				"V" String	2.3	0	2.9	1.7	<b>8+2X</b>	2.5	13	
				Tension	2.3	0	2.9	1.7	<b>8+2X</b>	3.5	15	
		Urban	100	"I" String	2.3	1.9	1.7	2.1	<b>8.8+2X</b>	2.5	14	
				"V" String	2.3	0	1.7	1.0	<b>6.6+2X</b>	2.5	12	
				Tension	2.3	0	1.7	1.0	<b>6.6+2X</b>	3.5	14	

**Note: Swing angle (in degrees)= 35**

**Table-3 (summarized)**

**RIGHT OF WAY CALCULATION FOR NORMAL ROUTE, FOREST AREA, URBAN AREA / POPULATED AREA / APPROACH SECTION NEAR SUBSTATION**

<i>Voltage level</i>	<i>Configuration</i>	<i>Conductor type</i>	<i>Terrain</i>	<i>Ruling Span</i>	<i>String Type</i>	<i>RoW width (As per the current Practice (in m))</i>	<i>Revised RoW width in m (for compensation purpose)</i>
765kV D/C	Vertical	ACSR ZEBRA	Normal route without constraint	400	"I" String	<b>67</b>	<b>67</b>
					"V" String		
					Tension		
			Forest	300	"V" String	<b>67</b>	<b>56</b>
					Tension		
			Urban area / populated area / approach section near substation	250	"V" String	<b>67</b>	<b>54</b>
Tension							
765kV S/C	Vertical /Delta	ACSR BERSIMIS	Normal route without constraint	400	"I" String	<b>64</b>	<b>64</b>
					"V" String		
					Tension		
			Forest	300	"V" String	<b>64</b>	<b>54</b>
					Tension		

<i>Voltage level</i>	<i>Configuration</i>	<i>Conductor type</i>	<i>Terrain</i>	<i>Ruling Span</i>	<i>String Type</i>	<i>RoW width (As per the current Practice (in m))</i>	<i>Revised RoW width in m (for compensation purpose)</i>
			Urban area / populated area / approach section near substation	250	"V" String	64	52
					Tension		
765kV S/C	Horizontal	ACSR BERSIMIS	Normal route without constraint	400	"I" String	85	74
					"V" String		
					Tension		
			Forest	300	"V" String	85	65
					Tension		
			Urban area / populated area / approach section near substation	250	"V" String	85	62
Tension							
±800kV HVDC	Horizontal	ACSR Lapwing	Normal route without constraint/Forest/ Urban	400	"Y" String	69	69
					Tension		
±500kV HVDC	Horizontal	ACSR Lapwing	Normal route without constraint/Forest/ Urban	400	"V" String	52	52
					Tension		
400kV D/C	Vertical	ACSR MOOSE	Normal route without constraint	400	"I" String	46	46
					"V" String		
					Tension		



Voltage level	Configuration	Conductor type		Ruling Span	String Type	RoW width (As per the current Practice (in m))	Revised RoW width in m (for compensation purpose)
			Forest	300	"V" String Tension	46	40
			Urban area / populated area / approach section near substation	250	"V" String Tension	46	38
400kV S/C	Horizontal/ Vertical	ACSR MOOSE	Normal route without constraint	400	"I" String "V" String Tension	52	52
			Forest	300	"V" String Tension	52	47
			Urban area / populated area / approach section near substation	250	"V" String Tension	52	44
1200kV	Horizontal	ACSR Moose	Normal route without constraint/Forest/ Urban	400	"V" String	89	89
220kV D/C	Vertical	ACSR ZEBRA	Normal route without constraint	350	"I" String "V" String Tension	35	32

<i>Voltage level</i>	<i>Configuration</i>	<i>Conductor type</i>	<i>Terrain</i>	<i>Ruling Span</i>	<i>String Type</i>	<i>RoW width (As per the current Practice (in m))</i>	<i>Revised RoW width in m (for compensation purpose)</i>
			Forest	300	"V" String Tension	<b>35</b>	<b>28</b>
			Urban area / populated area / approach section near substation	200	"V" String Tension	<b>35</b>	<b>24</b>
132kV D/C / 110 kV D/C	Vertical	ACSR PANTHER	Normal route without constraint	320	"I" String	<b>27</b>	<b>25</b>
					"V" String		
					Tension		
			Forest	200	"V" String	<b>27</b>	<b>21</b>
					Tension		
			Urban area / populated area / approach section near substation	150	"V" String	<b>27</b>	<b>19</b>
Tension							
66kV	Vertical	ACSR PANTHER	Normal route without constraint	250	"I" String	<b>18</b>	<b>18</b>
					"V" String		
					Tension		
			Forest	150	"V" String	<b>18</b>	<b>14</b>
					Tension		

<i>Voltage level</i>	<i>Configuration</i>	<i>Conductor type</i>	<i>Terrain</i>	<i>Ruling Span</i>	<i>String Type</i>	<i>RoW width (As per the current Practice (in m))</i>	<i>Revised RoW width in m (for compensation purpose)</i>
			Urban area / populated area / approach section near substation	100	"V" String	18	13
					Tension		

**Table 3 (detailed)**

**RIGHT OF WAY CALCULATION FOR NORMAL ROUTE, FOREST AREA, URBAN AREA / POPULATED AREA / APPROACH SECTION NEAR SUBSTATION**

Voltage level	Configuration	Conductor type	Terrain	Ruling Span	String Type	Width of right of way (in m)		Maximum Horizontal distance of Conductor attachment point from centre of tower (in m)	Approx. Width of right of way (in m)	RoW width (As per the current Practice (in m))	Revised RoW width in m (for compensation purpose)	Reduction in RoW	**Indicative base width of normal tower at Concrete level (in m)
(1)		(2)	(3)	(4)	(5)	(6)		(7)	(8)	(9)	(10)	(11)	(12)
A		B		C		R=2(D+H)+2 X		X	R				
765kV D/C	Vertical	ACSR ZEBRA	Normal route without constraint	400	"I" String	42+	2X	12.5	67	67	67	0	16 - 25
					"V" String	33.2+	2X	10.5	54				
					Tension	33.2+	2X	14.5	62				
			Forest	300	"V" String	27+	2X	10.5	48	67	56	11	16 - 25
					Tension	27+	2X	14.5	56				
			Urban area / populated area / approach section near substation	250	"V" String	25+	2X	10.5	46	67	54	13	16 - 25
					Tension	25+	2X	14.5	54				

765kV S/C	Vertical /Delta	ACSR BERSIMIS	Normal route without constraint	400	"I" String	43.2+	2X	10.5	64	64	64	0	13 - 19
					"V" String	35+	2X	9.5	54				
					Tension	35+	2X	13	61				
			Forest	300	"V" String	28.4+	2X	9.5	47	64	54	10	13 - 19
					Tension	28.4+	2X	13	54				
			Urban area / populated area / approach section near substation	250	"V" String	25.8+	2X	9.5	45	64	52	12	13 - 19
Tension	25.8+	2X			13	52							
765kV S/C	Horizontal	ACSR BERSIMIS	Normal route without constraint	400	"I" String	43.2+	2X	15.6	74	85	74	11	12 - 15
					"V" String	35+	2X	14.4	64				
					Tension	35+	2X	18.2	71				
			Forest	300	"V" String	28.4+	2X	14.4	57	85	65	20	12 - 15
					Tension	28.4+	2X	18.2	65				
			Urban area / populated area / approach section near substation	250	"V" String	25.8+	2X	14.4	55	85	62	23	12 - 15
Tension	25.8+	2X			18.2	62							
±800kV HVDC	Horizontal	ACSR Lapwing	Normal route without	400	"Y" String	44.4+	2X	12.3	69	69	69	0	14 - 21

			constraint/ Forest/ Urban										
±500kV HVDC	Horizon tal	ACSR Lapwing	Normal route without constraint/ Forest/ Urban	400	"V" String	<b>31.8+</b>	<b>2X</b>	8.2	--	52	52	4	12.5 - 16.5
400kV D/C	Vertical	ACSR MOOSE	Normal route without constraint	400	"I" String	<b>31+</b>	<b>2X</b>	7.5	<b>46</b>	<b>46</b>	<b>46</b>	<b>0</b>	<b>10-18</b>
					"V" String	<b>26.4+</b>	<b>2X</b>	6.0	<b>38</b>				
					Tension	<b>26.4+</b>	<b>2X</b>	9.7	<b>46</b>				
			Forest	300	"V" String	<b>20.6+</b>	<b>2X</b>	6.0	<b>33</b>	<b>46</b>	<b>40</b>	<b>6</b>	<b>10-18</b>
					Tension	<b>20.6+</b>	<b>2X</b>	9.7	<b>40</b>				
			Urban area / populated area / approach section near substation	250	"V" String	<b>18.2+</b>	<b>2X</b>	6.0	<b>30</b>	<b>46</b>	<b>38</b>	<b>8</b>	<b>10-18</b>
Tension	<b>18.2+</b>	<b>2X</b>			9.7	<b>38</b>							
400kV S/C	Horizon tal/ Vertical	ACSR MOOSE	Normal route without constraint	400	"I" String	<b>31+</b>	<b>2X</b>	10.5	<b>52</b>	<b>52</b>	<b>52</b>	<b>0</b>	<b>8-11</b>
					"V" String	<b>26.4+</b>	<b>2X</b>	9.1	<b>45</b>				
					Tension	<b>26.4+</b>	<b>2X</b>	13.0	<b>52</b>				
			Forest	300	"V" String	<b>20.6+</b>	<b>2X</b>	9.1	<b>39</b>	<b>52</b>	<b>47</b>	<b>5</b>	<b>8-11</b>
Tension	<b>20.6+</b>	<b>2X</b>			13.0	<b>47</b>							

			Urban area / populated area / approach section near substation	250	"V" String	18.2+	2X	9.1	36	52	44	8	8-11
						Tension	18.2+	2X	13.0	44			
1200kV	Horizontal	ACSR Moose	Normal route without constraint/ Forest/ Urban	400	"V" String	41.2+	2X	24	89	89	89	0	16 - 18
220kV D/C	Vertical	ACSR ZEBRA	Normal route without constraint	350	"I" String	22.6+	2X	4.6	32	35	32	3	6 - 12
					"V" String	19.8+	2X	4	28				
					Tension	19.8+	2X	5.7	31				
			Forest	300	"V" String	17+	2X	4	25	35	28	7	6 - 12
					Tension	17+	2X	5.7	28				
			Urban area / populated area / approach section near substation	200	"V" String	12.6+	2X	4	21	35	24	11	6 - 12
Tension	12.6+	2X			5.7	24							
132kV D/C /110 kV D/C	Vertical	ACSR PANTHER	Normal route without constraint	320	"I" String	17+	2X	3.9	25	27	25	2	5 - 9
					"V" String	14.4+	2X	3.5	21				
					Tension	14.4+	2X	5.3	25				

			Forest	200	"V" String	10+	2X	3.5	17	27	21	6	5 - 9
					Tension	10+	2X	5.3	21				
			Urban area / populated area / approach section near substation	150	"V" String	8.4+	2X	3.5	15	27	19	8	5 - 9
					Tension	8.4+	2X	5.3	19				
66kV	Vertical	ACSR PANTHER	Normal route without constraint	250	"I" String	12.5+	2X	2.5	18	18	18	0	4 - 7
					"V" String	10.4+	2X	2.5	15				
					Tension	10.4+	2X	3.5	17				
			Forest	150	"V" String	7.3+	2X	2.5	12	18	14	4	4 - 7
					Tension	7.3+	2X	3.5	14				
			Urban area / populated area / approach section near substation	100	"V" String	6.1+	2X	2.5	11	18	13	5	4 - 7
Tension	6.1+	2X			3.5	13							

Note: (1) For normal Route without constraint , RoW width= Maximum of RoW ( corresponding to I-string configuration, V string configuration , tension insulator)

Note: (2) For urban area/ forest , RoW width= Maximum of RoW ( corresponding to V string configuration , tension insulator)



Note: (3) Typical 765kV D/C Tower diagram with "I" string & "V" string is attached at Annex. A

Note: (4) \*\* Lower values of base width corresponds to suspension tower / small angle towers and higher values corresponds to higher angle towers

Note: (5) For  $\pm 500$  kV HVDC,  $\pm 800$  kV HVDC and 1200 kV HVAC lines, the reduction in RoW is not possible as it violates the minimum electrical field requirement at the edge of RoW (i.e 5kV/m at 1.8m height)

Annex-A

