सत्यमेव जयते

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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.

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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,

24/09/2024

(भंवर सिंह मीना /Bhanwar Singh Meena)

निदेशक/Director

Copy to:

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

भारत सरकार
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विद्युत मंत्रालय
नई दिल्ली

Government of India
Central Electricity Authority
Ministry of Power
New Delhi

September, 2024

Index

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 11th 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 16th 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 16th 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:

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

Where φ - 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.**

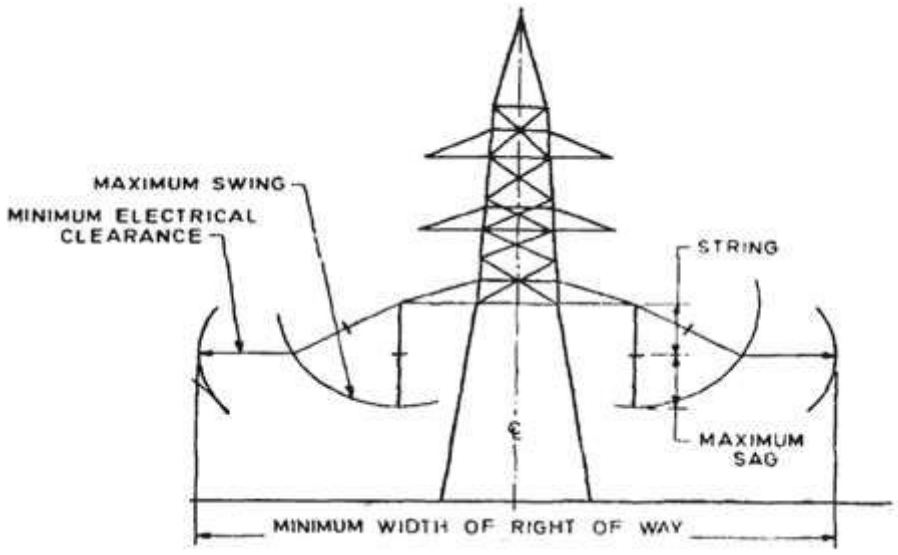


Figure-1

(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 16th 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-III**. The RoW may vary with change in any of the above parameters. RoW for different parameters may be calculated as per **Annexure-I.**

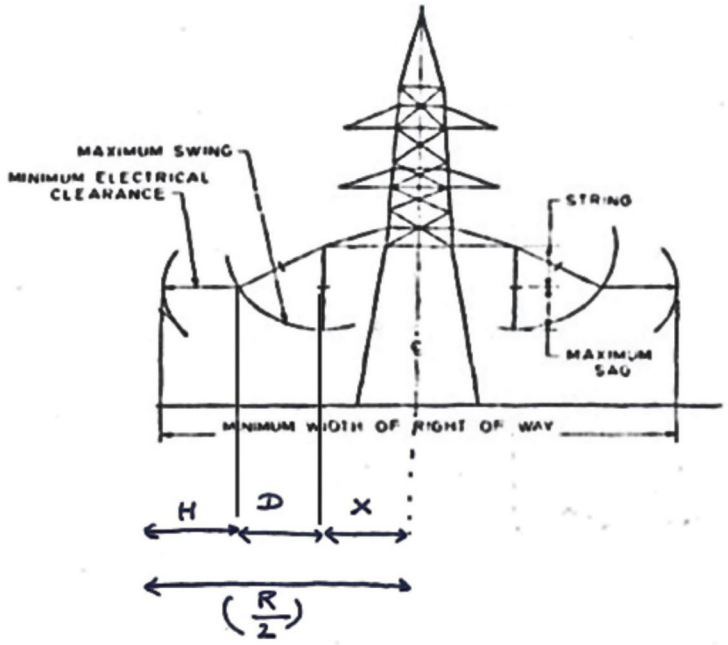
(h) Reduction of RoW using Insulated Cross Arm (ICA) was also discussed by the Committee as one of the technological options. However, since the use of insulated cross arm is not much in practice in Indian transmission system, the verified data could not be received for calculation of RoW. However, if any utility wants to use insulated cross arm, the formula given in **Annexure-I** may be utilized considering all safety aspects.

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

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

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, $D = (I+S)* \sin(\theta)$

Where,

θ = 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:

R = 2*(H+D) *If (H+D > X)*

R = H+D+X *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 for Normal Route, Forest Area, Urban Area / Populated Area / Approach Section near Substation for *Pole Structures with ACSR conductor*

Voltage Level	Configuration	Conductor type	Terrain	Design Span(m)	String Type	ROW width (m)
765 kV S/C	Vertical DELTA	ACSR BERSIMIS	Normal route without constraints	250	Tension	**52**
					I String	
			Forest area	250	Tension	**46**
			Urban area/Populated area/approach section near substation		V String	
400 kV D/C	Vertical	ACSR MOOSE	Normal route without constraint	250	Tension	**36**
					I String	
			Forest area	250	Tension	**31**
			Urban area/Populated area/approach section near substation		V String	
220 kV D/C	Vertical	ACSR ZEBRA	Normal route without constraint	350	Tension	**31**
					I String	
			Forest area	250	Tension	**26**
					I String	
					V String	
			Urban area/Populated area/approach section near substation	200	Tension	**24**
					I String	
					V String	
132 kV D/C	Vertical	ACSR Panther	Normal route without constraint	325	Tension	**25**
					I String	

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

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

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

					String	
					V String	
			Forest area	250	Tension	
					I String	
					V String	**23**
			Urban area/Populated area/approach section near substation	200	Tension	
					I String	**22**
					V String	
220kV D/C	Vertical	ACSS Dia:28.04 mm	Normal route without constraint	350	Tension	
					I String	**33**
			Forest area	250	Tension	
					I String	
					V String	**27**
			Urban area/Populated area/approach section near substation	200	Tension	
					I String	
					V String	**25**
220kV D/C	Vertical	GAP Dia:27.1mm	Normal route without constraint	350	Tension	
					I String	**31**
			Forest area	250	Tension	
					I String	
					V String	**26**
			Urban area/Populated area/approach section near substation	200	Tension	
					I String	**24**
					V String	
132 kV	Vertical	CFCC	Normal route	320	Tensi	

D/C		Dia:21 mm	without constraint		on I String	**22**
			Forest area	200	Tension I String V String	**18**
			Urban area/Populated area/approach section near substation	150	Tension I String V String	**17**
132 kV D/C	Vertical	ACSS Dia:20.5 mm	Normal route without constraint	320	Tension I String V String	**26**
			Forest area	200	Tension I String V String	**21**
			Urban area/Populated area/approach section near substation	150	Tension I String V String	**19**
132 kV D/C	Vertical	GAP Dia:20.60 mm	Normal route without constraint	320	Tension I String	**25**
			Forest area	200	Tension I String V String	**20**
			Urban area/Populated area/approach section near substation	150	Tension I String V String	**19**

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 / V String / Tension	400	**43**
		ACSS	Normal Route	I string / V String / Tension	400	**50**
		GAP	Normal Route	I string / V String / Tension	400	**48**
		CFCC	Forest	V String / Tension	300	**38**
		ACSS	Forest	V String / Tension	300	**43**
		GAP	Forest	V String / Tension	300	**41**
		CFCC	Urban/ Populated	V String / Tension	250	**35**
		ACSS	Urban/ Populated	V String / Tension	250	**40**
		GAP	Urban/ Populated	V String / Tension	250	**38**
220 kV D/C	Vertical	CFCC	Normal Route	I string / V String / Tension	350	**27**
		ACSS	Normal Route	I string / V String / Tension	350	**33**

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

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

Note:

a) *Conductors Diameter as given in Table-2 has been considered.*
b) *Carbon Fiber Composite Core (CFCC); Sag is calculated at 180 °C.*
c) *Aluminium Conductor Steel Supported (ACSS): Sag is calculated at 250 °C.*
d) *GZTACSR: Gap-type Aluminium Conductor Steel Reinforced (GAP conductor); Sag is calculated at 210 °C.*
e) *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.*

Appendix-I

File No.CEA-PS-14-86/2/2019-PSETD Division 89

I/29895/2023

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,
<As per addresses>

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-Convenerof committee

Copy to:

SA to Member (PS)

तीसरा तल सेवा भवन, रा माकृष्ण पुरम, सेक्टर -1, नई दि ल्ली -110 066, ई-मेल: ce-psetd@gov.in, फ़ोन: 01126732304
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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.

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

Where φ *- 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.

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.

4

Addresses:

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2

Annexure-I

List of Participants:

CEA

1. Shri Ramesh Kumar, Chief Engineer, PSETD Division
2. Smt. Rishika Sharan, Chief Electrial 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 Indigrid

1. Shri. Sudhir Nayak, Indigrid

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

5

Appendix-II

I/32053/2023 File No.CEA-PS-14-86/2/2019-PSETD Division

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: 30.11.2023

सेवा में,

<as per addresses >

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

The 2nd 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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4.	Director General,	EPTA	Dg.epta@epta.in epta.dg@gmail.com
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6.	Chief Engineer	PCD, CEA	cepcd.cea@gov.in
7.	Shri K. H. Rathod, I/C CE (Project)	GETCO	aceproject.getco@gebmail.com md.getco@gebmail.com
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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.com md@dtl.gov.in
14.	Shri Asis Panda Shri Sreedhar Reddy	Valmont Structures Private Limited	asis.panda@valmont.com G.Reddy@valmont.com
15.	Shri Kailash Deshmukh	M/s Bajel Projects Ltd.	monal.wagh@bajelprojects.com pradeep.mv@ bajelprojects.com

2

	Shri Pradeep M V Shri Monal Wagh		Kailash.deshmukh@bajelprojects.com

3

Minutes of 2nd 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.

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

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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6

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 Nirmit
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 Indigrid
1. Shri. Arnab Chakraborty

M/s Renew Power

7

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,

8

Appendix-III

File No.CEA-PS-14-86/2/2019-PSETD Division 130

'34256/2024

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: 05.03.2024

सेवा में,

<as per addresses >

विषय: Minutes of 3rd 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

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6.	Chief Engineer	PCD, CEA	cepcd.cea@gov.in
7.	Shri K. H. Rathod, I/ C CE (Project)	GETCO	aceproject.getco@gebmail.com md.getco@gebmail.com
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12.	Shri Jaydeep Ganguly	Tokyo Rope International Inc	jaydeep.ganguly@tokyorope.jp
13.	Shri Ram Kumar	DTL	dgmplanning.dtl2016@gmail.com md@dtl.gov.in

Minutes of 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

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

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.

---***---

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 Nirmit
- 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

Appendix-IV

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

<As per addresses >

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

The 4th 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 28/05/2024

(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

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13.	Shri Ram Kumar	DTL	dgmplanning.dtl2016@gmail.com md@dtl.gov.in

Annexure

Minutes of 4th 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

Appendix-V

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

<As per addresses >

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

The 5th 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

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Annexure

Minutes of 5th 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 Karnataka.
(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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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

By

Power System Engineering & Technology Development

Central Electricity Authority

भारत सरकार
केन्द्रीय विद्युत प्राधिकरण
विद्युत मंत्रालय
नई दिल्ली

Government of India
Central Electricity Authority
Ministry of Power
New Delhi

September, 2024