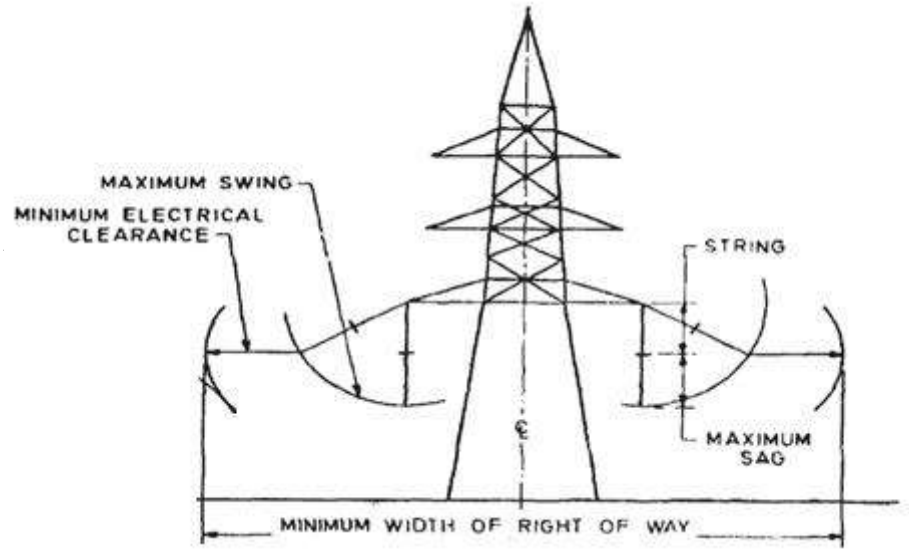

4.3 As per current practice, the width of RoW / corridor requirement for the transmission lines of different voltage levels are as follows.

Table -1

Voltage Level	Corridor Requirement (m)
66kV AC	18
110kV AC	22
132kV AC	27
220kV/230 kV 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

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.

4.4 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-XII**.

4.5 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

4.6 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 is 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.

4.7 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.

4.8 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.

4.9 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.

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

4.11 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.

4.12 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. In view of above, **normally the 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**.

Further reduction in RoW requirement at various voltage levels with the advancement of technology (maintaining adequate safety clearances) vis-à-vis as given in this report would

be allowed subject to the approval of CEA. In such cases, compensation for the reduced RoW requirement would be applicable.

4.13 Similarly, the base width of the tower can be optimized, and the **compensation shall be paid for actual base width of tower.** The tower base width/area will include the area bounded by concrete (as visible from outside) of the four legs of the tower. The indicative base width of tower is given under column (12) in the **Table-3 (Detailed)** for different voltage levels.

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 recommendations are yet to be adopted by most of the States.

b) 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.

c) For the purpose of this guidelines, the definition of Urban area is as below:

All places with a municipality, corporation, cantonment board or notified town area committee. etc

d) 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.

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 follow**s:**

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	320	200	150
110 kV	305	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 normally 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.

Further reduction in RoW requirement at various voltage levels with the advancement of technology (maintaining adequate safety clearances) vis-à-vis as given in this report would be allowed subject to the approval of CEA. In such cases, compensation for the reduced RoW requirement would be applicable.

(v) The base width of the tower can be optimized, and **the compensation shall be paid for actual base width of tower.** The tower base width/area will include the area bounded by concrete (as visible from outside) of the four legs of the tower The indicative base width of tower is given under column (12) in the **Table-3 (Detailed)** for different voltage levels.

(vi) For ±500 kV HVDC, ± 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)

(vii) 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.

(viii) 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.

(ix) 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 Steel pole	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

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.

****

IN WITNESS WHEREOF, the undersigned being duly authorized thereto have signed this Report of the Committee for payment of compensation in regard to Right of Way (RoW) for transmission lines in urban areas.

(Sanjiv N Sahai) Chairman of the Committee, Addl Secretary, Ministry of Power	(Ghanshyam Prasad) Member of the Committee, Chief Engineer (Trans),M/o Power	(PS Mhaske) Member of the Committee, Chairperson,CEA.
(P. Ravi Kumar) Member of the Committee, Addl. Chief Secretary (Energy), Government of Karnataka.	(Alok Kumar) Member of the Committee, Principal Secretary (Energy), Government of UP.	(Arvind Singh) Member of the Committee, Principal Secretary (Energy), Govt. of Maharashtra.
(Dr. B. Ashok) Member of the Committee, Secretary (Energy), Government of Kerala.	(T. C. Gupta) Member of the Committee, Addl Chief Secretary (Power), Govt. of Haryana.	(_____) Member of the Committee, CMD, Power Grid Corporation of India Limited.
(Ravinder Gupta) Convener & Member Secretary, Chief Engineer (PSPA-I), CEA	—	—

Appendix-I

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

Dated 11th 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 Dhan Yojna.

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.

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

Appendix-II

Minutes of the meeting taken by Ms. Shalini Prasad, Additional Secretary, Ministry of Power on 30.08.2016 regarding finalization of compensationinregard to Right of Ways (RoW) for transmissionlines 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.

Annex-I
F.No. 3/4/2016-Trans

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.

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
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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: setshvpnpkl@gmail.com

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Appendix-III

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
   (ii) 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.

Sl. No.	Name Shri/Smt	Designation
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.	Upender 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 Lightening Surges				To withstand Switching surges					
(b)		Minimum horizontal clearances as per Safety Regulations									

Appendix-IV

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 SecretaryMinistry 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.