



भारत सरकार

Government of India

विद्युत मंत्रालय

Ministry of Power

केंद्रीय विद्युत प्राधिकरण

Central Electricity Authority

विद्युत प्रणाली योजना एवं मूल्यांकन प्रभाग-II

Power System Planning & Appraisal Division-II

सेवा में / To,

(विद्युत क्षेत्र में सभी हितधारक और आम जनता /

All Stakeholders in Power Sector & General Public)

**विषय : केंद्रीय विद्युत प्राधिकरण (ट्रांसमिशन प्लानिंग क्रिटेरिया पर मैनुअल), 2023 के संशोधन- I पर सुझाव/टिप्पणियां प्रस्तुत करने की अंतिम तिथि का विस्तार ।**

**Subject: Extension of last date for submitting suggestions / comments on Amendment-I to the Central Electricity Authority (Manual on Transmission Planning Criteria), 2023.**

महोदया (Madam)/ महोदय (Sir),

In continuation to our letter dated 18<sup>th</sup> July 2024 (copy enclosed) vide which all the stakeholders in Power Sector were requested to send their views/suggestions (if any) on the Amendment-I to the Central Electricity Authority (Manual on Transmission Planning Criteria), 2023 to CEA by 16<sup>th</sup> August 2024.

Some of the power sector utilities have requested to extend the last date of submission of suggestions / comments on Amendment-I to the Central Electricity Authority (Manual on Transmission Planning Criteria), 2023.

Therefore, the last date for submission of the comments / suggestions on the Manual is extended to 31<sup>st</sup> August, 2024.

भवदीय/Yours faithfully,

Signed by Rahul Raj

Date: 16-08-2024 17:34:28

(राहुल राज / Rahul Raj)

निदेशक/ Director



सत्यमेव जयते

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केंद्रीय विद्युत प्राधिकरण

**Central Electricity Authority**

विद्युत प्रणाली योजना एवं मूल्यांकन प्रभाग-II

**Power System Planning & Appraisal Division-II**

सेवा में / To,

(विद्युत क्षेत्र में सभी हितधारक और आम जनता /  
All Stakeholders in Power Sector & General Public)

विषय: केंद्रीय विद्युत प्राधिकरण (ट्रांसमिशन प्लानिंग क्रिटेरिया पर मैनुअल), 2023 के संशोधन-I पर सुझाव/टिप्पणियां आमंत्रित करने के लिए नोटिस।

**Subject: Notice inviting suggestions / comments on Amendment-I to the Central Electricity Authority (Manual on Transmission Planning Criteria), 2023.**

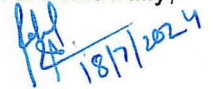
महोदया (Madam)/ महोदय (Sir),

The Central Electricity Authority (CEA) has issued the Manual on Transmission Planning Criteria, 2023. The Manual was effective from 1<sup>st</sup> April, 2023. In order to cover the planning procedure, new chapter (Chapter-7) is proposed to be added. Further, parameters of certain conductors need to be updated. The draft amendment to the Manual, incorporating above changes is enclosed herewith.

All stakeholders in Power Sector and general public are hereby requested to kindly send their views/suggestions (if any) on the draft of Amendment-I to the Central Electricity Authority (Manual on Transmission Planning Criteria), 2023 by 16<sup>th</sup> August, 2024 at the address given below, so that same could be appropriately considered while finalizing the Amendment-I to the Manual.

Sh. B.S. Bairwa,  
Chief Engineer (PSPA-II),  
Central Electricity Authority,  
3<sup>rd</sup> Floor, Sewa Bhawan (N), R.K.Puram,  
New Delhi-110066  
Email id: cea-pspa2@gov.in

भवदीय/Yours faithfully,

  
18/7/2024

(राहुल राज / Rahul Raj)  
निदेशक/ Director

# **Draft Amendment-I to the Central Electricity Authority (Manual on Transmission Planning Criteria), 2023**

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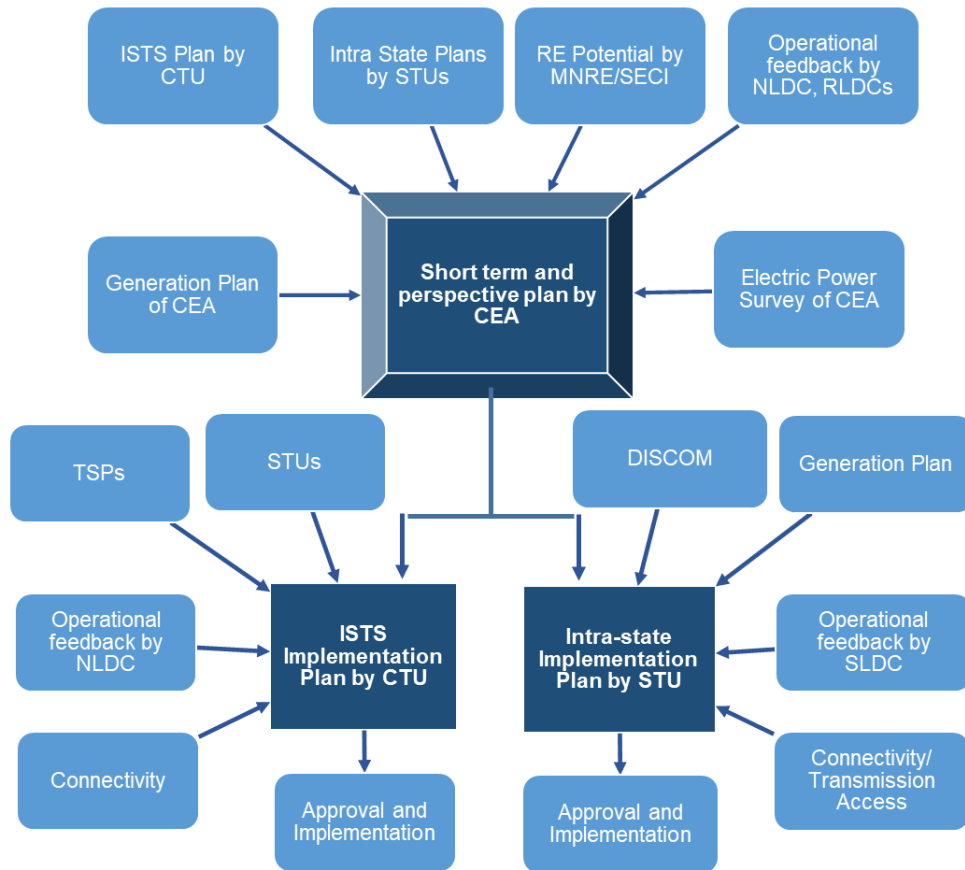
## **Chapter 7      PROCEDURE FOR PLANNING OF ELECTRIC POWER TRANSMISSION SYSTEM**

### **7.1      Planning of Electric Power Transmission System**

- 7.1.1 The principle for planning of the ISTS shall be to ensure that it is available as per the requirements of the States and the generators, as reflected by their General Network Access (GNA)/connectivity requests. Similarly, Intra-STS shall ensure availability of generators and loads. As far as possible, the transmission system shall be planned and developed matching with growth of generation and load and care shall be taken that there is no wasteful investment.
- 7.1.2 CEA shall draw up short term plan every year on rolling basis for up to next five years and perspective plan every alternate year on rolling basis for next ten years in accordance with Electricity (Transmission System Planning, Development and Recovery of Inter-State Transmission Charges) Rules 2021. While preparation of Short term and perspective plan, CEA shall consult with CTU, STU, MNRE, RPCs, SECI, NLDC, RLDCs, generators etc. Details of preparation of plans is given in Paragraph 7.2.
- 7.1.3 In line with section 38 of the Electricity Act, 2003, CTU shall undertake transmission of electricity through inter-State transmission system, discharge all functions of planning and co-ordination relating to inter-State transmission system. CTU shall draw up plan for Inter-State Transmission System for up to next five years on rolling basis every year in accordance with Electricity (Transmission System Planning, Development and Recovery of Inter-State Transmission Charges) Rules 2021.
- 7.1.4 For preparing implementation plan of ISTS, Central Transmission Utility (CTU) shall consult the State Transmission Utilities (STUs) , Central Government, State Governments, generating companies, Regional Power Committees (RPCs), Central Electricity Authority (CEA), System Operators, licensees and any other person notified by the Central Government in this behalf. The entities intend to use ISTS shall give their network access requirement well in advance considering time required for implementation of the transmission assets. Details of preparation of implementation plan of ISTS by CTU is given Paragraph 7.3.
- 7.1.5 In line with Section 39 of the Electricity Act, 2003, STU shall act as the nodal agency for Intra-STS planning in coordination with distribution licensees and intra-state generators connected/to be connected in the STU grid. The STU

shall be the single point contact for the purpose of ISTS planning and shall be responsible on behalf of all the intra-State entities for evacuation of power from their State's generating stations, meeting requirements of DISCOMs and exchange of power with ISTS commensurate with the ISTS plan with due consideration to the margins available in the existing system.

- 7.1.6 PM Gati Shakti National Master Plan (PMGS-NMP) provides a digital platform for integrated planning and coordinated implementation of infrastructure projects. The information available on this platform is to be used while planning of transmission system. For planning of any new transmission lines or substations, the portal of PMGS-NMP is to be used. PM-Gatishakti will facilitate optimum route planning of transmission lines by avoiding/minimizing crossing of railways, highways, restricted areas, forest cover, GIB, defence, airports and habitat areas etc.
- 7.1.7 For strengthening of the transmission network cost, reliability, right-of way requirements, transmission losses, down time (in case of up-gradation and reconductoring options) etc need to be studied. If need arises, addition of new transmission lines/ substations to avoid overloading of existing system including adoption of next higher voltage may be explored.
- 7.1.8 All the transmission lines planned must have integrated communication plan which is necessary for safe and reliable operation of grid. Communication system for new transmission system shall be planned and implemented in accordance with Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022, and its amendments or re-enactment thereof, Central Electricity Authority (Technical Standards for Communication System in Power System Operations) Regulations, 2020 and its amendments or re-enactment thereof, and CEA Manual of Communication Planning in Power System Operation 2022 and its amendments such that the communication system is available at the time of commissioning of the transmission system
- 7.1.9 The transmission system shall be planned considering the provisions of this Manual and other relevant Rules/Regulations.
- 7.1.10 Flow chart of the planning is given below:



## 7.2 Short Term and Perspective Transmission system Plan by CEA

7.2.1 Section 3(4) of the Electricity Act, 2003, provides that the Authority shall prepare a National Electricity Plan in accordance with the National Electricity Policy and notify such plan once in five years. Further, Electricity (Transmission System Planning, Development and Recovery of Inter-State Transmission Charges) Rules, 2021, provides that Central Electricity Authority shall draw up short term plan every year on rolling basis for up to next five years and perspective plan every alternate year on rolling basis for next ten years for development of the electricity system and coordinate the activities of the planning agencies for the optimal utilization of resources to sub serve the interests of the National economy and to provide reliable and quality electricity to all consumers.

7.2.2 CEA shall consult relevant stakeholders for preparation of short term and perspective plan and for coordinating the activities of planning agencies through regional standing committees namely Standing Committee on Short Term and Perspective Power System Planning (SCSTPPSP).

7.2.3 Five number of regional standing committees namely “Standing Committee on Short Term & Perspective Power System Planning” one for each region has been constituted to review the existing and under implementation intra-state and inter-state transmission system in the region, review the operational

constraints faced by the system operators in the region, examination of new ISTS proposals and proposals from STUs/Electricity Departments and examine the associated transmission system for generating stations.

#### 7.2.4 Data requirement from various stakeholders:

- a) Data and information to be provided within CEA: Data related to electricity demand, ISTS & intra-state generation capacity addition/phasing out data, generation plan, and status of on-going transmission system.
- b) Data and information to be provided by CTU: All the planning related data and models in respect of Inter-State Transmission System (ISTS), generating stations connected to ISTS, transmission system requirements, relevant data for connectivity/ General Network Access (GNA) of generation project and drawing entities etc.
- c) Data and information to be provided by STUs: All the planning related data and models in respect of Intra-State Transmission System (In-STS), transmission system requirements, relevant data for connectivity/ GNA of generation project and drawl entities would be considered
- d) Data and information to be provided by Grid Operator: Information regarding signals of any congestion in any part of the ISTS and Intra-STS in respect of ICT and line loadings, over-voltages, fault levels, stability issues, etc. Historical data of ICT and line loadings, bus voltages, generation and demand profile etc for the purpose of study and analysis.
- e) Data and information to be provided by Regional Power Committees (RPCs): Facilitation in data collection from STUs, data related to protection coordination etc.
- f) Data and information to be provided by MNRE/SECI: Location of the RE potential along-with quantum of the potential including type of such RE Potential (Wind/Solar/Hybrid), details of offshore wind potential and time-frame in which the above potential is expected to materialize.

7.2.5 Concept to commissioning of transmission elements generally takes about three to five years; about two to three years for augmentation of capacitors, reactors, transformers etc. and about four to five years for new transmission lines or sub-stations. Therefore, system studies for firming up the transmission plans may be carried out with 3-5 year time horizon on rolling basis every year. These studies have to be carried out as per the Manual on Transmission Planning Criteria, 2023.

7.2.6 In accordance with the above, the procedure to be followed for preparation of short term, and perspective plan by CEA is as given below:

S. No.	Actions	Timelines
1.	Furnishing of data by various stakeholders	by 30 <sup>th</sup> April

2.	Analysis of data, carrying out load flow studies and preparation of draft report	by 31 <sup>st</sup> July
3.	Time to be given to constituents for comments on draft report and incorporation of additional system, if any	August
4.	Meeting with stakeholders on regional basis	September - October
5.	Incorporation of comments, carrying out studies and preparation of Final Report	30 <sup>th</sup> November
6.	Issue of Final Report	31 <sup>st</sup> December

7.2.7 Load-generation scenarios shall be worked out as per the requirements so as to reflect the daily and seasonal variations in electricity demand and generation availability (such as cases for peak, off-peak and other than peak / off-peak hours for different seasons considering low, moderate and high renewable/other generation dispatch).

7.2.8 While planning the transmission system, options of upgrading the existing ISTS in place of building new transmission lines (such as increasing the line loading through use of compensation, reconductoring, etc.) shall be explored for optimally utilizing the existing assets.

7.2.9 To avoid bottling up of power, STUs shall also plan and implement their downstream networks along with the evolved inter-state transmission system in similar time-frame.

7.2.10 The short term and perspective plan consists of broad inter-state and intra-state transmission system requirement of the country which includes:

- Growth of transmission system in India
- Transmission planning philosophy and development process
- New technologies in transmission system
- Studies and Analysis
- Transmission system requirements.

7.2.11 States may also have their own short term and perspective transmission plan based on the CEA's integrated short term and perspective plan.

### 7.3 Implementation Plan of ISTS by CTU

7.3.1 The Central Transmission Utility shall draw up plan for Inter-State Transmission System for up to next five years on rolling basis every year identifying specific transmission projects which are required to be taken up along with their implementation time lines, considering the plans made by Central Electricity Authority and studying the progress in generation capacity and demand in different parts of the country as well as taking note of General Network Access requests made by Designated Inter-state Customers, any signals of any

congestion in any part of the Inter-State Transmission System and difficulties in obtaining right of way for development of transmission corridors. For preparing this plan, Central Transmission Utility shall consult the State Transmission Utilities, Central Government, State Governments, Central Electricity Authority, Regional Power Committees, generating companies, System Operators, licensees and any other person notified by the Central Government in this behalf.

- 7.3.2 The principle for planning of the Inter-State Transmission System shall be to ensure that it is available as per the requirements of the stakeholders, as reflected by their Connectivity and General Network Access requests. The transmission system shall be planned and developed matching with growth of generation and load, as far as possible, and while doing the planning, care shall be taken that best possible techno-economical alternative is taken up for implementation.
- 7.3.3 CTU shall be the nodal agency for compilation of data required for formulation of basic network data file (base case files) for the purpose of ISTS planning.
- 7.3.4 Data requirement from various stakeholders
- a) Data and information to be provided by CEA: Short term and perspective plan for development of the transmission system.
  - b) Data and information to be provided by STUs: All the planning related data and models in respect of Intra-State Transmission System (In-STS), generating stations connected to In-STS etc.
  - c) Data and information to be provided by Generators: Generators connected or intending to connect to ISTS shall submit their technical data including validated models (electro-mechanical and electro-magnetic) in a comprehensive manner.
  - d) Data and information to be provided by ISTS Transmission Licensees: Steady state and dynamic data pertaining to transmission line, substation equipment, HVDC, FACTS etc.
  - e) Data and information to be provided by Regional/National Load Despatch Centre: Information regarding signals of any congestion in any part of the ISTS in respect of ICT and line loadings, over-voltages, fault levels, stability issues etc and historical data of ICT and line loadings, bus voltages, generation and demand profile etc for the purpose of study and analysis.
  - f) Data and information to be provided by Regional Power Committees (RPCs): Facilitate CTU in respect of data collection from STUs, data related to protection coordination
  - g) Data and information to be provided by MNRE: Location of the RE potential (Wind/Solar/Hybrid) along-with quantum and timeframe, details of offshore



wind potential, demand potential on account of Green Hydrogen/Ammonia production facilities etc.

- h) Data from Applications of Connectivity / General Network Access:  
Applications for grant of Connectivity or grant of GNA.

### 7.3.5 Planning Timelines:

The entire process for transmission planning shall be undertaken on continuous basis, involving two cycles in a year i.e. from April to September (interim) and October to March (final). The ISTS Planning cycle is tabulated below:

Sl. No.	Activity	Concerned entity	1 <sup>st</sup> cycle: Apr-Sep	2 <sup>nd</sup> cycle: Oct-March
1.	Data Collection by CTU:			
	<ul style="list-style-type: none"> <li>Inputs regarding plans made by CEA (short term and perspective plans for next ten years)</li> </ul>	MNRE, CTU, CEA, STUs, RPCs, and GRID INDIA	01 <sup>st</sup> to 30 <sup>th</sup> April	01 <sup>st</sup> to 31 <sup>st</sup> October
	<ul style="list-style-type: none"> <li>Open Access / General Network Access / Cross border transaction requests made by Designated Interstate Customers / other entities</li> </ul>			
	<ul style="list-style-type: none"> <li>Data to be submitted by the STUs (to be facilitated - by RPCs)</li> </ul>			
	<ul style="list-style-type: none"> <li>Transmission constraints along with operational data to be submitted by System Operators to CTU</li> </ul>			
	<ul style="list-style-type: none"> <li>RE related inputs to be provided by MNRE</li> </ul>			
2.	Data validation and preparation of Load-Generation Balance (LGBs) Scenarios at All India level for different scenarios through joint consultation in separate regional meetings	CTU, CEA, STUs, RPCs, and GRID INDIA	15 <sup>th</sup> June	15 <sup>th</sup> December
3.	Preparation of base case files for identified LGB(s) at All India level	CTU	30 <sup>th</sup> June	31 <sup>st</sup> December
4.	Single or Multi Regional Joint System studies for evolution of new ISTS schemes and / or augmentation of existing system	CTU, CEA, GRID INDIA, and concerned RPC(s) & STU(s)	31 <sup>st</sup> July	31 <sup>st</sup> January
5.	Preliminary proposal along with assumptions on CTU website for stakeholders' comments	CTU	15 <sup>th</sup> August	15 <sup>th</sup> February

6.	Final Report		31 <sup>st</sup> October	31 <sup>st</sup> March
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7.3.6 The report shall comprise of power supply scenario, load generation balance, measures taken to mitigate the envisaged issues in the grid, system studies and analysis, ISTS scheme etc.

#### 7.4 Implementation plan of Intra-State Transmission System by STU

7.4.1 As per Section 39 of the Electricity Act, 2003, State Transmission Utility shall be responsible to undertake transmission of electricity through Intra-State transmission system, to discharge all functions of planning and co-ordination relating to intra-State transmission system with Central Transmission Utility, State Governments, generating companies, Regional Power Committees, Authority, licensees, any other person notified by the State Government. STU to ensure development of an efficient, co-ordinated and economical system of intra-State transmission lines for smooth flow of electricity from generating stations to the load centres and to provide non-discriminatory open access to its transmission system.

7.4.2 Based on the perspective plan of Central Electricity Authority, STUs to make their own plan considering Intra-state generation capacity addition/phasing out of transmission system, load growth, operational feedback etc.

##### 7.4.3 Data requirement

- a) Data and information to be provided by DISCOMS: Node-wise electricity demand data of State.
- b) Data and information to be provided by SLDC: Information regarding signals of any congestion in any part of the intra state in respect of ICT and line loadings, over-voltages, fault levels, stability issues etc and historical data of ICT and line loadings, bus voltages, generation and demand profile etc for the purpose of study and analysis.
- c) Data and information to be provided by Bulk Consumers: Anticipated electricity demand data (if any).
- d) Data from Applications of Connectivity/General Network Access: Applications for grant of connectivity or grant of GNA.
- e) Information regarding plan of augmentation of ISTS network in the State: From plan of CEA and CTUIL.

##### 7.4.4 Timelines

S. No.	Actions	Concerned entity	Timelines
1.	Data Collection by STU:		

	<ul style="list-style-type: none"> <li>Inputs regarding plans made by CEA (short term &amp; perspective plans for next ten years)</li> </ul>	CEA,	01 <sup>st</sup> to 30 <sup>th</sup> April
	<ul style="list-style-type: none"> <li>Open Access / General Network Access /other entities</li> </ul>	DISCOMS, Bulk Consumer	
	<ul style="list-style-type: none"> <li>Transmission constraints along with operational data to be submitted by System Operators to STU</li> </ul>	SLDC	
2.	Data validation and preparation of Load-Generation Balances (LGBs) at State level for different scenarios through joint consultation in separate meetings	STU	30 <sup>th</sup> June
3.	Preparation of base case files for identified LGB(s) at State level	STU	
4.	Draft Plan along with assumptions on STU website for stakeholders' comments	STU	15 <sup>th</sup> August
5.	Stakeholders' comments on the preliminary proposal	Stakeholders	31 <sup>st</sup> August
6.	Finalisation of transmission schemes considering comments / suggestions of stakeholders and uploading of the final Plan on STU website	STU	30 <sup>th</sup> September

7.4.5 Load-generation scenarios shall be worked out as per Manual on Transmission Planning Criteria of CEA including daily and seasonal variations in demand and generation availability (such as peak, off-peak and other than peak / off-peak hours for different seasons considering low, moderate and high renewable/other generation capacity).

7.4.6 The implementation plan for intra-state transmission system shall comprise of power supply scenario, load generation balance, system studies and analysis, details of Intra-state transmission scheme, measures taken to mitigate the constraints envisaged in the grid etc.

## 7.5 Approval and Implementation

### 7.5.1 Approval of ISTS Projects:

- 7.5.1.1 Ministry of Power, Govt. of India vide office order dated 28.10.2021 has revised the Terms of Reference (TOR) for National Committee on Transmission. As per the point No. 2 (viii) of amended terms of reference:

*“The NCT shall recommend to Ministry of Power (MoP) for implementation of the ISTS projects with cost more than Rs 500 crore, along with their mode of implementation i.e. Tariff Based Competitive Bidding (TBCB) / Regulated Tariff Mechanism (RTM), as per the existing Tariff Policy. However, the NCT shall approve the ISTS costing between Rs 100 crore to Rs.500 crore or such limit as prescribed by MoP from time to time, along with their mode of implementation under intimation to MoP. The ISTS costing less than or equal to Rs. 100 crores, or such limit as prescribed by MoP from time to time, will be approved by the CTUIL along with their mode of implementation under intimation to the NCT and MoP. After approval of the ISTS by the NCT or the CTU (as the case may be), the TBCB project shall be allocated to Bid Process Coordinators through Gazette Notification, while the RTM project shall be allocated to CTU.”*

- 7.5.1.2 MoP vide letter dated 3<sup>rd</sup> July, 2023 has amended para 2 (ix) of the ToR of NCT as follows:

*"National Committee on Transmission (NCT) will appoint BPCs for all the projects costing more than Rs 100 Crore and will communicate corresponding BPC immediately so that the respective BPCs can start survey work for the particular project"*

CTU will plan the ISTS project, in consultation with CEA, consult with RPCs (for projects costing more than Rs 500 Cr.), place it before NCT, and NCT to submit its recommendations to Gol for approval.

## 7.5.2 Implementation of ISTS Project

- 7.5.2.1 As per National Tariff Policy 2016, while all future inter-state transmission projects shall, ordinarily, be developed through competitive bidding process, the Central Government may give exemption from competitive bidding for implementation through Regulated Tariff Mechanism (RTM) mode for (a) specific category of projects of strategic importance, technical upgradation etc. or (b) works required to be done to cater to an urgent situation on a case-to-case basis.

The respective approving agencies shall also approve mode of implementation of the transmission project. Further, NCT to finalise Bid Process Coordinators (BPCs) for the transmission schemes to be implemented through Tariff Based Competitive Bidding route. Bidding timelines should be followed as per the standard bidding documents (SBD).

7.5.2.2 The BPCs shall submit the survey report for the transmission schemes within 60 days from the date of NCT meeting. Based on the survey report, implementation timeframe of the scheme shall be worked out.

7.5.3 Approval and Implementation of Intra-State Project

7.5.3.1 In regard to implementation of intra-state transmission system, the Tariff Policy notified on 28<sup>th</sup> January, 2016 provides that –

*“5.3 The tariff of all new generation and transmission projects of company owned or controlled by the Central Government shall continue to be determined on the basis of competitive bidding as per the Tariff Policy notified on 6<sup>th</sup> January, 2006 unless otherwise specified by the Central Government on case to case basis.*

*Further, intra-state transmission projects shall be developed by State Government through competitive bidding process for projects costing above a threshold limit which shall be decided by the SERCs.”*

7.5.3.2 STU shall plan and implement the Intra-state Transmission Schemes keeping in view the above provisions.

## Annexure- II

**DATA FOR TRANSMISSION PLANNING STUDIES****Table- I(a)****(Line parameters (per unit / km / circuit, at 100 MVA base)**

Actual system data based on actual tower dimensions, wherever available, should be used. In cases where data is not available standard data given below can be assumed:

Voltage (kV)	Config.	Type of conductor	Ckt	Positive sequence			Zero sequence		
				R	X	B	R <sub>0</sub>	X <sub>0</sub>	B <sub>0</sub>
765	Quad	@ACSR Bersimis	S/C	1.951E-6	4.880E-5	2.35E-2	4.500E-5	1.800E-4	1.406E-2
	Hexa	@ACSR Zebra	D/C	2.096E-6	4.360E-5	2.66E-2	3.839E-5	1.576E-4	1.613E-2
	Hexa	#ACSR Zebra	D/C	2.076E-6	4.338E-5	2.675E-2	3.662E-5	1.582E-4	1.605E-2
	Hexa	#AL59 (61/3.08)	D/C	2.056E-6	4.351E-5	2.671E-2	3.660E-5	1.583E-4	1.609E-2
400	Twin	ACSR Moose	S/C	1.862E-5	2.075E-4	5.55E-3	1.012E-4	7.750E-4	3.584E-3
	Twin	ACSR Moose	D/C	1.800E-5	1.923E-4	6.02E-3	1.672E-4	6.711E-4	3.669E-3
	Twin	AL59 (61/3.31)	D/C	1.871E-5	1.946E-4	5.980E-3	1.556E-4	6.777E-4	3.650E-3
	Twin	ACSR Lapwing	S/C	1.230E-5	1.910E-4	6.08E-3	6.685E-5	7.134E-4	3.926E-3
	Twin	ACSR Lapwing	D/C	1.204E-5	1.905E-4	6.08E-3	1.606E-4	6.651E-4	3.682E-3
	Twin	Moose eq. AAAC	S/C	1.934E-5	2.065E-4	5.67E-3	1.051E-4	7.730E-4	3.660E-3
	Triple	ACSR Zebra	S/C	1.401E-5	1.870E-4	5.86E-3	7.616E-3	6.949E-4	3.783E-3
	Triple	ACSR Snowbird	D/C	1.193E-5	1.721E-4	6.733E-3	1.477E-3	6.499E-4	3.950E-3
	Quad	ACSR Zebra	S/C	1.050E-5	1.590E-4	6.60E-3	5.708E-3	5.940E-4	4.294E-3
	Quad	ACSR Bersimis	S/C	7.416E-6	1.560E-4	7.46E-3	4.031E-3	5.828E-4	4.854E-3
	Quad	ACSR Moose	S/C	9.167E-6	1.580E-4	7.32E-3	1.550E-4	6.250E-4	4.220E-3
	Quad	ACSR Moose	D/C	9.177E-6	1.582E-4	7.33E-3	1.557E-4	6.246E-4	4.237E-3
	Quad	AL59 (61/3.31)	D/C	9.506E-6	1.594E-4	7.299E-3	1.439E-4	6.318E-4	4.221E-3
	Quad	Moose eq. AAAC	S/C	9.790E-6	1.676E-4	6.99E-3	5.320E-3	6.260E-4	4.510E-3
220	Twin	ACSR Moose	S/C	4.304E-5	5.819E-4	1.98E-3	4.200E-4	2.414E-3	1.107E-3

Voltage (kV)	Config.	Type of conductor	Ckt	Positive sequence			Zero sequence		
				R	X	B	R <sub>0</sub>	X <sub>0</sub>	B <sub>0</sub>
	Single	ACSR Zebra	S/C	1.440E-4	8.220E-4	1.41E-3	4.231E-4	2.757E-3	8.843E-4
	Single	ACSR Drake	S/C	1.800E-4	8.220E-4	1.41E-3	6.1E-4	2.56E-3	8.050E-4
	Single	ACSR Moose	S/C	1.547E-4	8.249E-4	1.42E-3	4.545E-4	2.767E-3	8.906E-4
	Single	ACSR Kunda	S/C	1.547E-4	8.249E-4	1.42E-3	4.545E-4	2.767E-3	8.906E-4
	Single	AAAC Zebra	S/C	1.547E-4	8.249E-4	1.42E-3	4.545E-4	2.767E-3	8.906E-4
	Single	ACSR Zebra	D/C	1.416E-4	8.227E-4	1.407E-3	5.398E-4	2.676E-3	8.869E-4
	Single	ACSR Moose	D/C	1.152E-4	8.078E-4	1.433E-3	5.137E-4	2.661E-3	9.074E-4
	Twin	ACSR Zebra	D/C	7.049E-5	5.842E-4	2.006E-3	4.692E-4	2.437E-3	1.132E-3
	Twin	ACSR Moose	D/C	5.772E-5	5.767E-4	2.003E-3	4.563E-4	2.429E-3	1.118E-3
	Twin	AL59 ZEBRA	D/C	7.027E-5	5.885E-4	1.973E-3	4.672E-4	2.442E-3	1.118E-3
	Twin	AL59 Moose	D/C	6.132E-5	5.851E-4	1.990E-3	4.583E-4	2.438E-3	1.127E-3
132	Single	ACSR PANTHER	S/C	9.310E-4	2.216E-3	5.10E-4	2.328E-3	9.310E-3	
	Single	ACSR PANTHER	D/C	7.823E-4	2.323E-3	4.950E-4	1.957E-4	7.606E-3	3.138E-4
66	Single	ACSR DOG	S/C	3.724E-3	8.864E-3	1.28E-4			
	Single	ACSR DOG	D/C	6.299E-3	1.024E-2	1.242E-4	1.103E-2	3.305E-2	8.171E-5

@: With 15m ground clearance

#: With 18m ground clearance