

Overview of Transmission Adequacy

16.12.2024

Transmission Planning Criteria & its Evolution

- ▶ **Manual on Transmission Planning Criteria was first brought out by CEA in 1985** setting the planning philosophy of regional self-sufficiency. The manual was revised in 1994 considering the experience gained on EHV systems. Technological advancements and institutional changes necessitated further review of the Transmission Planning Criteria.
- ▶ The Electricity Act, 2003, has brought profound changes in electricity supply industry of India leading to unbundling of vertically integrated State Electricity Boards, implementation of Open Access in power transmission and liberalisation of generation sector, among others.
- ▶ The phenomenal growth of private sector generation and the creation of open market for electricity have brought its own uncertainties. Large numbers of generation projects are coming up with no information regarding firm beneficiaries. Adequate flexibility needs to be built in the transmission system to cater to such uncertainty, to the extent possible.

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- ▶ Given the uncertainties, the possibility of stranded assets or congestion cannot be entirely ruled out. In creation of very large interconnected grid, there can be unpredictable power flows leading to overloading of transmission lines due to imbalance in load generation in different pockets of the grid in real time operation.
- ▶ Reliable transmission planning is basically a trade-off between the cost and the risk involved. There are no widely adopted uniform guidelines which determine the criteria for transmission planning vis-à-vis acceptable degree of adequacy and security. Practices in this regard vary from country to country. The common theme in the various approaches is "acceptable system performance".

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- ▶ As the National grid grew in size and complexity, grid security was required to be enhanced considering large scale integration of renewable energy sources. Therefore, the transmission planning criteria was reviewed again in the year 2013.
- ▶ The regional electrical grids of Northern, Western, Southern, Eastern and North-Eastern regions have been synchronously interconnected in December 2013 to form one of the largest synchronous electricity grid in the world. The country has moved from the concept of regional self-sufficiency to bulk inter-regional transfer of power through high capacity AC and HVDC corridors forming an all-India National Grid.

Transmission Planning Criteria & its Evolution

- ▶ Ministry of Power has promulgated Electricity (Transmission System Planning, Development and Recovery of Inter-State Transmission Charges) Rules, 2021, in October 2021, paving the way for complete overhauling of transmission system planning to give power sector utilities easier access to electricity transmission network across the country. These Rules underpin that transmission planning shall be done in such way that the lack of availability of the transmission system does not act as a barrier on the growth of different regions and the transmission system shall, as far as possible, be planned and developed matching with growth of generation and load. While doing the transmission planning, care shall be taken that there is no wasteful investment. These rules also introduced General Network Access (GNA) in the inter-state transmission system.
- ▶ In context with anticipated large-scale renewable generation capacity addition, growth of load, increasing fault level, right of way issues, technological advancement and notification of Transmission Rules 2021, the **'Manual on Transmissions Planning Criteria' has been revised in 2023.**

Analysis and Studies for adequacy of transmission

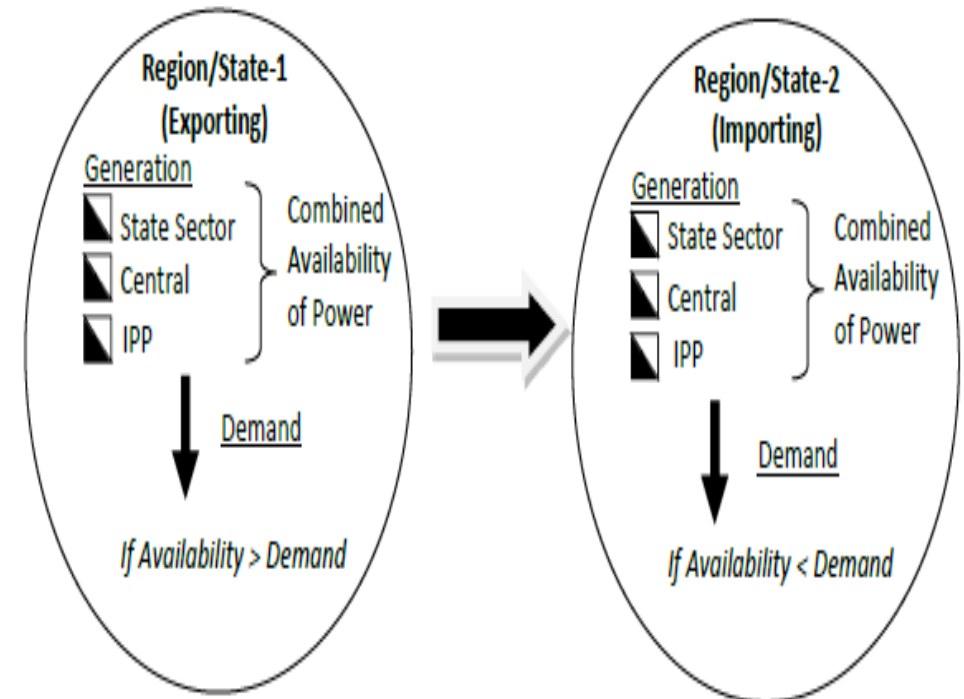
- ▶ Expansion of the transmission system depends on the projected electricity demand and the generation capacity addition.
- ▶ For planning of transmission system, peak electricity demand projection, demand variations over various seasons/months during a year as well as daily variations in electricity demand are required as the flow on transmission lines keep on varying based on load-generation scenarios throughout the year.
- ▶ With high share of RE in the grid, the RE generation pattern is also equally important in planning of transmission system as power flow on the transmission lines may totally change and a net exporting region/state during high RE generation scenario may become a net importing region/state in low RE generation scenario.

Analysis and Studies for adequacy of transmission

- ▶ In any state, there can be State sector generation tied up completely to the host state, Central sector generating station serving more than one State as well as generating stations with 100% share of the host state, and Inter-State IPPs.
- ▶ Each State has its own electricity demand with typical variation in demand throughout the year. The net electricity demand of a State and power availability from all the sources in the State gives the net import or export of that State.
- ▶ The aggregation of import or export requirements of States within a region, and taking into consideration the diversity factor in electricity demand, translates into inter-regional power transfer requirements. Transmission system has been planned to meet the projected electricity demand considering the import/export requirements.

Load Generation Balance Approach

- ▶ In order to find out the requirement of the transmission system, it is important to find out the surplus/deficit of each Region/State under various scenarios which would give the import/export requirement of respective Region/State.
- ▶ For this, the total power available within a Region/State shall be considered based on the generation projects physically located in the Region/State irrespective of its classification.
- ▶ Based on the combined availability of power from the Central sector/State sector/IPP generation projects in the Region / State as well as the projected electricity demand, the import/export requirement shall be worked out as shown.



Challenges faced in implementation of Transmission System

- ▶ The specific data in respect of generation and load is a must for conducting power flow studies, which determines the operating state of the system for given load generation balance in the system and to further plan the required transmission system to evacuate the power efficiently from the generation centre to the load centre.
- ▶ The concept to commissioning of necessary transmission elements generally takes about three to five years from its start date; about two to three years for augmentation of capacitors, reactors, transformers etc., and about four to five years for new transmission lines or substations. Further, as per Central Electricity Planning Criteria, it is the mandate for the transmission customers as well as utilities to give their network access requirement well in advance considering time required for implementation of the transmission assets. The transmission customers are also required to provide a reasonable basis for their transmission requirement such as size and completion schedule of their generation facility, demand and their commitment to bear transmission service charges.

Challenges faced in implementation of Transmission System

- ▶ Further, the Central Electricity Authority, Ministry of Power, Govt. of India is also directing KPTCL to furnish the transmission resource adequacy study file as of at the end of 2026-27 immediately.
- ▶ The main challenges faced by implementing agencies in completion of transmission projects include delay in forest clearance, problems of Right of Way and compensation issues, problem in acquisition of land for sub-stations, contractual issues etc.



Thank You