

Government of India

Ministry of Power

Central Electricity Authority

Resource Adequacy Plan for Transmission System of Punjab up to the year 2035-36

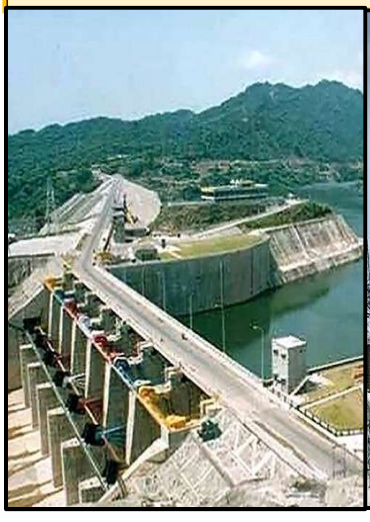






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Executive Summary

Punjab, owing to its growing electricity demand driven by urbanization, industrial development, agricultural activities, infrastructure expansion, and increasing commercial and domestic consumption, requires a reliable and robust transmission network. The state is a significant power-consuming region, with substantial demand arising from its agricultural and industrial sectors, while also being an integral part of the interconnected Northern Regional Grid. Therefore, strengthening the transmission system is essential for efficient evacuation and transfer of power from generating stations, meeting the increasing demand across urban and rural areas, facilitating integration of renewable energy, and ensuring reliable and uninterrupted power supply to consumers.

In June 2026, Punjab witnessed an all-time peak demand of 17,672, which is about 6% higher than the peak demand of 16,670 MW in 2025-26. As per the revised 20th Electric Power Survey (EPS) Report, peak electricity demand in Punjab is projected to increase to 19,860 MW by 2030-31 and to about 22,500 MW by 2035-36.

A comprehensive system study for strengthening of the transmission network in Punjab has been carried out by CEA in association with PSTCL, CTUIL, Grid-India and Resource Adequacy Plan has been prepared, indicating the transmission capacity required to be added in Punjab till the year 2035-36. The studies have been carried out on the basis of data/inputs furnished by Punjab (PSTCL).

At present, the existing intra-state transformation capacity in Punjab is around 39,970 MVA (at 220 kV & above voltage level), which is planned to be increased to 56,810 MVA by 2030-31 and 69,170 MVA by 2035-36.

Similarly, the existing intra-state transmission line length is around 9,908 ckm (at 220 kV & above voltage level), which is planned to be increased to 11,744 ckm by 2030-31 and 12,383 ckm by 2035-36.

To ensure uninterrupted 24x7 power supply to the consumers & evacuation of power from planned generation projects, implementation of the planned transmission system needs to be expeditiously taken up by PSTCL.

Chapter-1

Power supply scenario in Punjab and projected electricity demand

1.1 Background

Punjab, one of the agriculturally and economically important states of northern India, is characterized by its fertile alluvial plains, extensive agricultural lands, well-developed irrigation infrastructure and a network of important rivers. The state is primarily drained by the Sutlej, Beas and Ravi River systems, which have historically played an important role in supporting agriculture, irrigation and economic activities. Punjab has a highly developed agricultural economy, particularly known for the cultivation of paddy, wheat and other major crops, along with a significant industrial and commercial base. Major urban and industrial centres such as Ludhiana, Amritsar, Jalandhar, Patiala, Bathinda, Mohali and other rapidly developing urban areas contribute significantly to the state's economic activity. With its high level of electrification, extensive agricultural pumping load, diversified industrial base and strategically important location in northern India, Punjab occupies an important position in the country's power sector. The state has a substantial electricity demand arising from domestic, agricultural, commercial, industrial and other consumers, while its power supply is supported through a combination of generation within the state, power procured from central generating stations and electricity sourced through the inter-State grid.

The power supply scenario in Punjab is characterized by a large and steadily increasing electricity demand, with substantial seasonal variations due to agricultural irrigation and weather-dependent residential and commercial loads. The state has a diversified power procurement and generation portfolio comprising thermal, hydroelectric and renewable energy sources. Thermal generation constitutes an important component of the state's power supply, supplemented by hydroelectric power and increasing penetration of solar and other renewable energy sources. Punjab also receives power from central generating stations and other generating stations located outside the state through long-term and other power procurement arrangements. The state has been progressively increasing the deployment of renewable energy, particularly solar power, including utility-scale projects as well as distributed and rooftop solar generation, in line with the national objective of increasing the share of clean energy in the electricity mix. The availability of power through the regional and national transmission grid further provides flexibility in meeting variations in demand and generation within the state.

Electricity distribution in Punjab is primarily managed by Punjab State Power Corporation Limited (PSPCL), which is responsible for the distribution and supply of electricity to a large and diverse

consumer base across the state. The distribution network caters to domestic, commercial, industrial, agricultural and public-service consumers located in major urban centres as well as extensive rural areas. Agricultural consumption constitutes a significant component of electricity demand in Punjab due to the widespread use of electric tubewells for irrigation. The state has undertaken continuous investments in strengthening and modernizing its transmission and distribution infrastructure, including augmentation of substations and transformers, strengthening of transmission and distribution lines, improvement of system reliability, reduction of technical and commercial losses and enhancement of the quality of electricity supply. The transmission system, operated by Punjab State Transmission Corporation Limited (PSTCL), plays a critical role in transferring power from generating stations and inter-State transmission corridors to major load centres across the state.

As Punjab continues to develop its urban, industrial and commercial sectors, its internal electricity requirements are expected to increase substantially. The growth in electricity demand is being driven by expansion of urban areas and cities such as Ludhiana, Amritsar, Jalandhar, Patiala, Bathinda, Mohali and other emerging urban centres, along with increasing industrial and commercial activities. Punjab has a well-established industrial base comprising textiles and hosiery, engineering goods, manufacturing, agro-processing, food processing, pharmaceuticals, chemicals, sports goods, bicycle and bicycle-component manufacturing and other small, medium and large-scale industries. Industrial and logistics development, expansion of existing industrial areas, growth of commercial establishments and increasing economic activity are expected to contribute significantly to future electricity demand. At the same time, increasing household electrification, rising appliance ownership, air-conditioning and cooling requirements, electrification of transport, growth of commercial loads and increasing mechanization of agricultural activities are likely to further increase electricity consumption and peak demand.

Punjab also experiences significant seasonal and diurnal variations in electricity demand. During the summer months, high temperatures result in substantial increases in residential, commercial and agricultural electricity consumption, particularly due to air-conditioners, coolers, fans and refrigeration loads. Agricultural electricity demand is also a major factor influencing the state's seasonal load profile and varies considerably according to irrigation requirements, cropping patterns and weather conditions. The paddy cultivation season can result in significant increases in agricultural pumping demand, particularly during periods of inadequate rainfall. During periods of extreme summer temperatures, the combined impact of agricultural pumping, residential cooling, commercial activity and industrial consumption can result in very high system peak demand. Consequently, maintaining adequate generation availability, power procurement arrangements, inter-

State transmission capability, intra-State transmission corridors and distribution infrastructure is essential for ensuring reliable electricity supply during periods of maximum system stress.

Looking ahead, electricity demand in Punjab is projected to grow steadily and substantially in line with economic development, urbanization, industrial expansion, infrastructure development, increasing cooling requirements and greater electrification of end-use sectors. The state's large agricultural load, coupled with growth in industrial, commercial and domestic consumption, will require continued augmentation and modernization of the transmission and distribution network. Meeting the projected demand will require adequate generation capacity, assured power procurement, strengthening of inter-State transmission corridors and reinforcement of the intra-State transmission system to facilitate reliable transfer of power to major load centres. Greater penetration of solar and other renewable energy sources will also necessitate adequate energy storage, flexible generation resources, improved forecasting and scheduling, demand-side management and enhanced grid-balancing mechanisms. The development of battery energy storage systems, pumped storage projects, smart-grid technologies, energy-efficiency measures and electric-vehicle charging infrastructure will become increasingly important for maintaining reliability, flexibility and resilience of the power system. With its significant agricultural consumption, established industrial base, growing urbanization and increasing integration of renewable energy, Punjab will remain an important state in the development of the northern regional power system and will require coordinated generation, transmission and resource adequacy planning to meet its future electricity requirements reliably and economically up to 2035-36.

1.2 Present Power Scenario in Punjab

1.2.1 Installed Generation Capacity

Punjab State Power Corporation Limited (PSPCL) is a state-owned power utility responsible for the generation and supply of electricity in Punjab and plays a significant role in meeting the state's electricity requirements. PSPCL operates a diversified portfolio of thermal and hydroelectric generating stations, with major thermal power stations including the Guru Gobind Singh Super Thermal Plant (GGSSTP), Ropar and Guru Hargobind Thermal Power Plant (GHTP), Lehra Mohabbat.

In addition to its existing generation portfolio, PSPCL is augmenting its generation capacity through new hydroelectric projects, including the Shahpur Kandi Hydroelectric Project, and through procurement and allocation of power from other generating stations. PSPCL's power supply is further supplemented by its share from BBMB, central-sector generating stations and other sources. The

state is also promoting renewable energy, particularly solar power, including rooftop, distributed and other renewable energy projects, to diversify the power supply mix and support the increasing integration of renewable energy into the state's electricity system.

Table 1.1: Installed Electricity Generation Capacity

	Capacity (MW)
State Sector	3828.70
Power tied up from Private Generating Stations	7052.58
Allocation from Central Generating Stations	4001.12
Total	**14882.41**

Source: Installed Capacity Report CEA, August, 2026

Table 1.2: Generation project connected to intra-state system

S. No.	**Generation Project**	**Capacity (MW)**
1	**PSPCL Projects**	
1.1	**Hydro Projects**	
	Anandpur Sahib Hydel Project (HEP)	134
	Mukerian Hydel Project Stage-I	225
	Ranjit Sagar Dam (Hydro Electric Project)	452 (600)
	Shanan Power House (Hydro Electric Project)	110
	U.B.D.C. HEP Stage I & II	91
	Total Small Hydro	59
1.2	**Thermal/Gas Projects**	
	GH TPS (Lehra Mohabbat)	920
	Goindwal Sahib TPP	540
	Ropar TPS	840
2	**Private Sector Projects**	
	Rajpura TPP	1400
	Talwandi Sabo TPP	1980
3	**Non-Conventional Projects (Solar & Biomass)**	
3.1	**Biomass and Co-Gen Power Projects**	365
3.2	**Solar Power Projects**	
	Intra-State Solar projects	942

	RTS (including PM Surya Ghar Yojana)	599

Punjab's electricity distribution is managed primarily by a single state-owned integrated utility, the Punjab State Power Corporation Limited (PSPCL) (formerly the Punjab State Electricity Board), operating under the jurisdiction of the state government.

1.2.2 Electricity Demand of Punjab

Till date, Punjab has witnessed an all-time high peak demand of 17672 MW in July 2026, which is about 6% higher than the peak demand of 16670 MW in 2025-26. From the analysis of peak demand of Punjab for past 10 years, it has been observed that peak demand of Punjab has grown @5% per year. The recorded peak demand of Punjab for ten years starting from FY 2016-17 is given in the Table 1.3.

Table 1.3 Recorded Peak Demand of Punjab

Sr. No.	Year	Peak Demand (MW)
1	2016-17	11408
2	2017-18	11705
3	2018-19	12638
4	2019-20	13606
5	2020-21	13148
6	2021-22	13431
7	2022-23	14311
8	2023-24	15293
9	2024-25	16058
10	2025-26	16670
11	2026-27 (till August)	17672

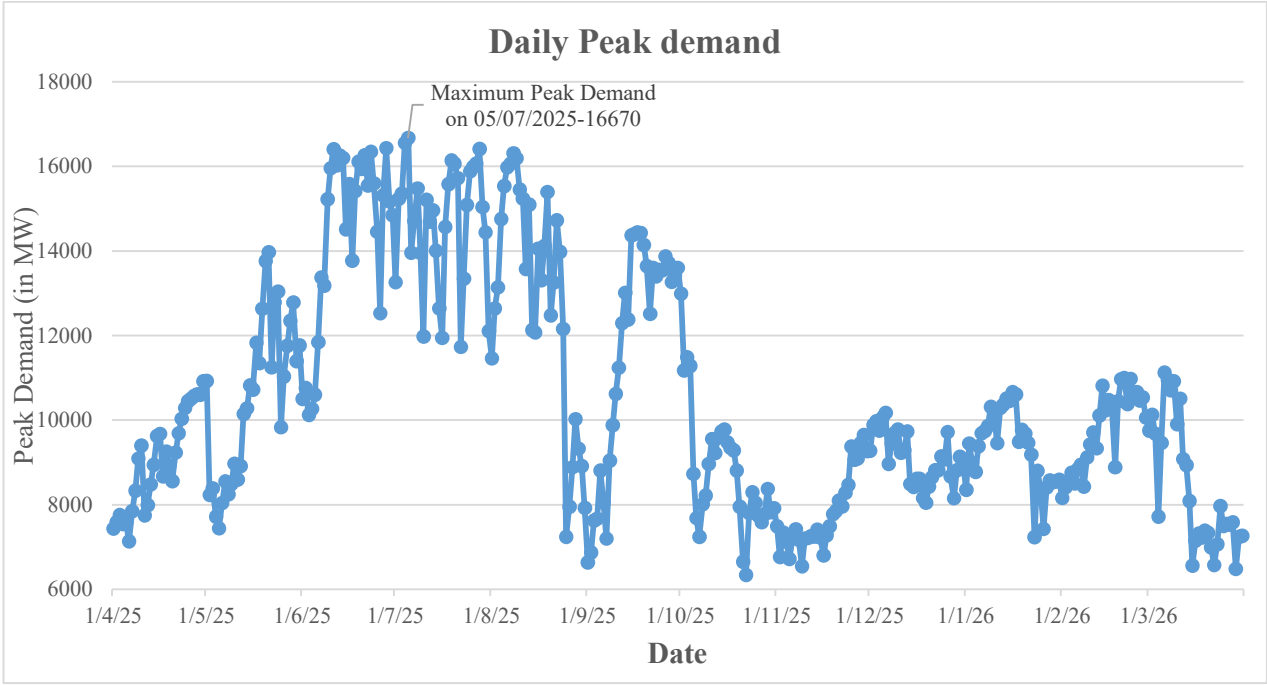


Figure 1.2.1: The daily peak demand observed for Punjab for F.Y. 2025-26

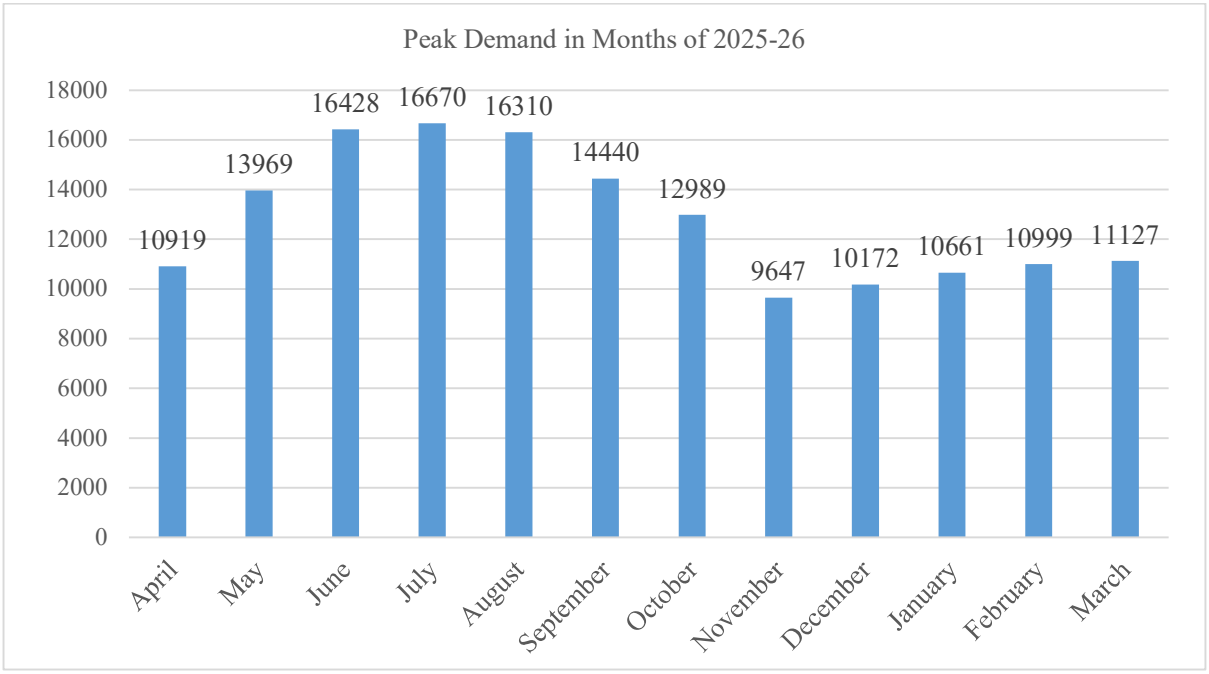


Figure 1.2.2: The Monthly variation of peak electricity demand in Punjab for 2025-26

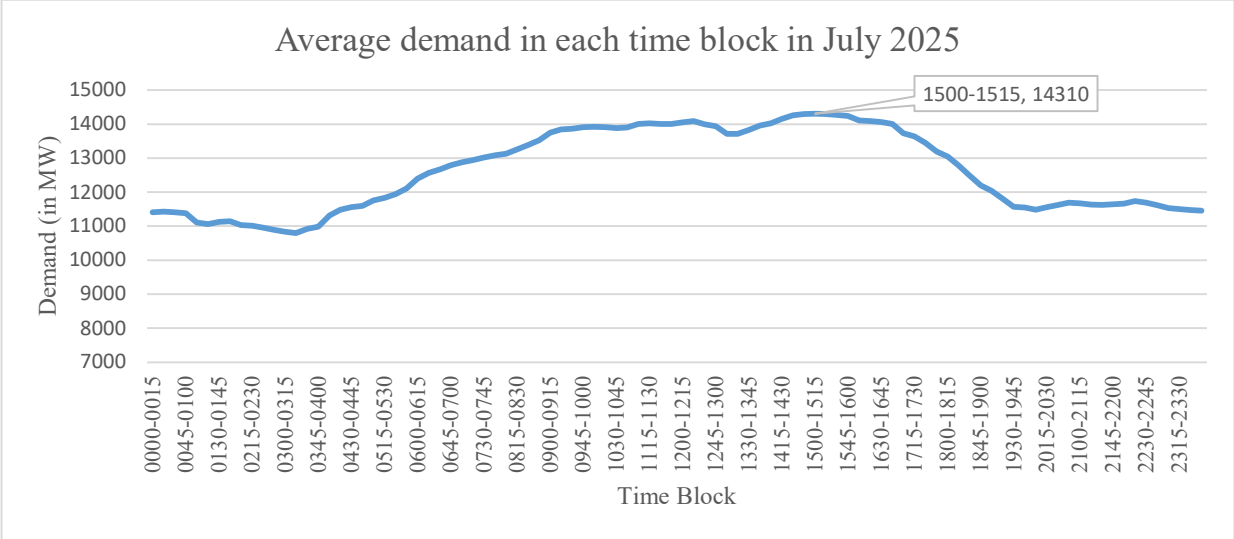


Figure 1.2.3: The hourly variation of electricity demand in Punjab for the month of July in 2025-26

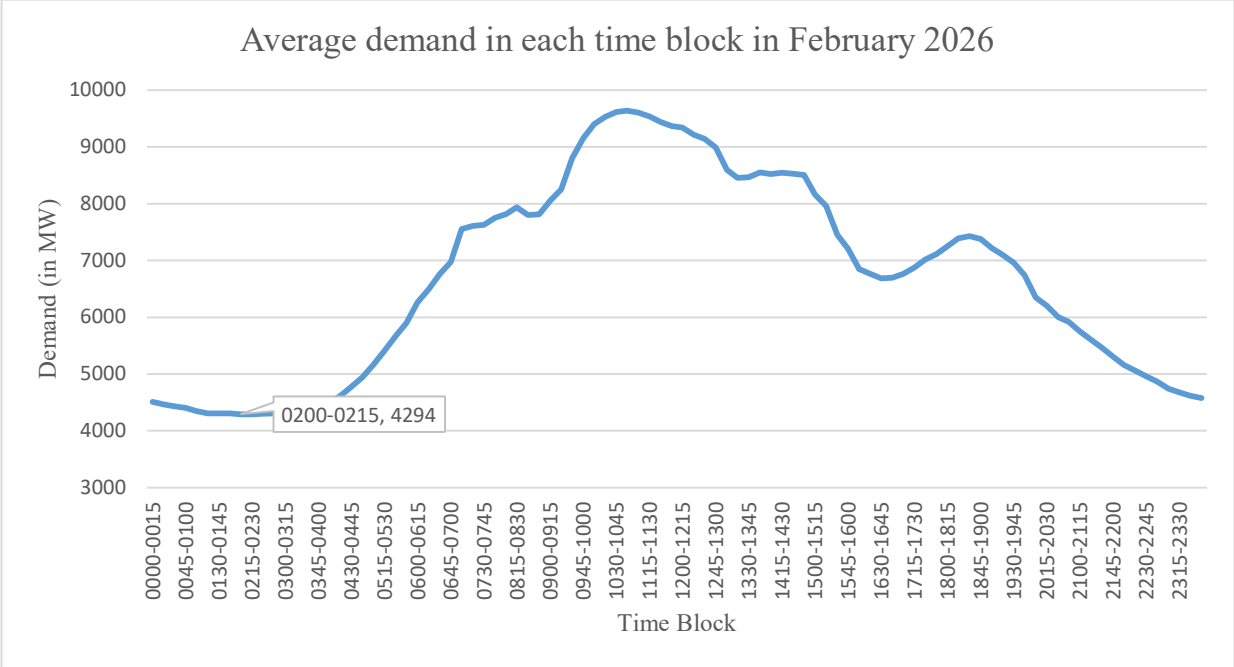


Figure 1.2.3: The hourly variation of electricity demand in Punjab for the month of February

1.3 Projected Electricity Demand of Punjab:

As per the revised 20th Electric Power Survey (EPS) Report, peak electricity demand is projected to increase to 19,860 by 2030-31 and 21834 MW by 2034-35. However, as per projections furnished by Punjab, the peak electricity demand of the state is projected to increase to 21,570 by 2030-31,

25477 MW by 2034-35 and 25,500 MW by 2035-36. Year wise projected electricity demand of Punjab is given in the Table 1.4 below:

Table 1.4: Projected electricity demand in Punjab

S. No.	Year	Peak demand (As per EPS) (MW)	Peak demand (Punjab Projections) (MW)
1	2025-26 (Actual)	16670	16670
2	2026-27 (Projection)	17668	17873
3	2027-28 (Projection)	18207	18767
4	2028-29 (Projection)	18791	19705
5	2029-30 (Projection)	19351	20690
6	2030-31 (Projection)	19860	21570
7	2031-32 (Projection)	20350	22486
8	2032-33 (Projection)	20858	23442
9	2033-34 (Projection)	21348	24438
10	2034-35 (Projection)	21834	25477
11	2035-36 (Projection)	-	25500

1.4 Existing Transmission Network in Punjab

Punjab has 6 Nos. of 400 kV substations namely Amritsar, Jalandhar, Ludlow/Malerkotla, Patran, Patiala and Ludhiana; and one 765 kV ISTS substation namely Moga (PG), however, Punjab doesn't has drawl from Moga S/s presently. In the intra-state transmission system, Punjab has 8 Nos. of 400 kV substations namely Dhuri, Makhu, Muktsar, Nakodar, Rajpura, Dhanansu, Ropar and Behman Jassa; and 109 Nos. of 220 kV substations operated by PSTCL.

1.4.1 Intra-State Transmission System in Punjab

The details of the existing transmission system which includes the number of Grid sub-station (GSS), transformation capacity (MVA), length of transmission lines (ckm) is shown in Table 1.5 and Table 1.6 below. Punjab has total 179 numbers of GSS (132 kV & above).

Table 1.5: Existing intra-state transmission system (Substations)

S.No.	Voltage level	Existing Intra- State transmission system (Substations) (PSTCL)	
		No of Substations	Transformation Capacity (in MVA)
1	400 kV	8	9990

			(400/220 kV: 9890, 220/66 kV: 100)
2	220 kV	109	30340 (220/66 kV: 26480, 220/132 kV: 3500)
3	132 kV	63	4584
	Total	**180**	**44554**

List of existing 400 kV Sub-stations (intra-state):

1. Shri Mukatsar Sahib: 2x315+500 MVA, 400/220 kV
2. Behman Jassa Singh: 2x500 MVA, 400/220 kV
3. Nakodar: 2x315+500 MVA, 400/220 kV
4. Makhu: 2x315+500 MVA, 400/220 kV
5. Dhanansu: 2x500 MVA, 400/220 kV
6. Balwan (Dhuri): 3x500 MVA, 400/220 kV
7. Rajpura: 4x500 MVA, 400/220 kV
8. Ropar: 2x500 MVA, 400/220 kV

Table 1.6: Existing intra-state transmission lines

S.No.	Voltage level	Transmission Lines	
		No of Circuits	Length (in ckm)
1	400 kV	27	1688
2	220 kV	293	8220
3	132 kV	161	3120
	Total	**481**	**13029**

Shunt Reactors:

Table 1.7: Details of existing Shunt Reactors in intra-state transmission system

S. No.	Sub-station	Voltage level (kV)	Bus Reactors (Nos.)	MVAR
1	Sri Mukatsar Sahib	400	1	80
2	Nakodar	400	1	80
3	Makhu	400	1	80
4	Dhuri	400	1	125
5	Nakodar	220	1	25
6	Dhuri	220	1	25
Total			**6**	**415**

Capacitor Banks:

The capacitor banks in PSPCL network are installed at 11/66/132 kV voltage level. General rating of each capacitor banks is 5.4 MVAR at 11 kV, 10.86 MVAR at 66 kV and 21.72/32.6 MVAR at 132 kV voltage level. Total 630 nos. capacitor banks have been installed in the PSPCL network with total capacity of 4182 MVAR. In addition, capacitor banks with capacity of 337 MVAR are under implementation, likely to be commissioned during 2026-2031.

1.4.2 Inter-State Transmission system (ISTS) in Punjab

The details of existing Inter-State transmission network in Punjab is given in Table 1.8 and Table 1.9:

Table 1.8: Existing Inter-State Transmission system (Substations)

S.No.	Voltage level	Existing Inter- State transmission system (Substations)	
		No of Substations	MVA
1	765/400/220 kV (Moga)	1	4815
2	400/220 kV	6	8835
	Total	**7**	**13650**

Table 1.9: List of 765 kV and 400 kV ISTS Substations:

S.No.	Sub-station	Voltage level (kV)	Total MVA
1	Moga-PG	765/400/220	4815
2	Amritsar	400/220	1630
3	Jallandhar	400/220	1130
4	Ludhiana	400/220	1815
5	Malerkotla	400/220	1130

6	Patiala	400/220	1630
7	Patran	400/220	1500

1.5 Constraints in Transmission Network in Punjab:

(i) Operational constraints in 400/220 kV ICTs at Intra-State substations in Punjab:

S. No.	Substation	Major Constraints	Remedial Solution
1	400 kV Muktsar	ICTs N-1 non-compliant during non-solar hours in summer/ paddy season.	220 kV Behman Jassa Singh - GNDTP Bathinda D/c line will relieve loading
2	400 kV Ropar	ICTs N-1 non-compliant in summer/paddy season.	Additional ICT at Malerkotla and 4th ICT at Rajpura will relieve loading

(ii) Other operational constraints in Intra-State Transmission System (220 kV and below transmission network):

S. No.	Transmission line	Major Constraints	Remedial Solution
1	220 kV Rajpura-Rajpura D/c line	Line operates beyond its rated capacity	Planned re-arrangement of 220kV circuits at Patiala – Rajpura – Mohali region to be expedited.
2	220 kV Nalagarh - Mohali D/c line	Line operates beyond its rated capacity	Erection of 220 kV Derabassi-Panchkula D/c line to be expedited. Along with proposed upgradation of 220 kV Mohali-1 substation
3	220 kV Rajpura-Lalru D/c line	Line operates beyond its rated capacity	Planned re-arrangement of 220 kV circuits at Patiala - Rajpura – Mohali region to be expedited.
4	220 kV GGSSTP (Ropar) - Kharar line	Line operates beyond its rated capacity	LILO of 2nd Ckt of 220 kV GGSSTP (Ropar) - Mohali-1 Line at Kharar.
5	220kV Patiala - Ablowal D/c Line	Line operates beyond its rated capacity	Erection of 220 kV Patiala (PGCIL) - Bhadson D/c along with upgradation of Bhadson S/s to 220 kV level to be expedited.
6	220 kV Patran - Banga line	Line operates beyond its rated capacity	LILO of 2nd ckt of Sunam - Patran line at Bangan
7	220 kV GHTP (Lehra) - GNDTP (Bathinda) D/c line	Line operates beyond its rated capacity	220 kV Behman Jassa Singh - GNDTP Bathinda D/c line to be expedited
8	220 kV Muktsar-Katorewala line	Line operates beyond its rated	220 kV Behman Jassa Singh – GNDTP Bathinda D/c line to be expedited

		capacity during non-solar hours.	
9	220 kV Dhanansu-Kohara line and Dhanansu-Gaunsgarh D/c line	Lines operates beyond its rated capacity	220 kV Dhanansu – Doraha D/c line and LILO of one ckt of 220 kV Ganguwal – Jamalpur D/c line at 400 kV Dhanansu to be expedited.
10	220 kV Amritsar-Verpal D/c line and Amritsar-Khassa D/c line	Lines operates near its rated capacity	Planned re-arrangement of 220 kV circuits at Naraingarh – Chogawan – Civil Line Amritsar region to be expedited.
11	220 kV Sarna-Kishanpur D/c line	Line operates much beyond its rated capacity	Proposed upgradation of 220 kV Wadala Granthian S/s to 400 kV level to be expedited.

(iii) Issues of higher MVAR drawl by Punjab from ISTS and low voltages observed in Intra-State network

During the high demand summer/paddy season in Punjab, low voltage issues are predominant in the state network. During summer season of 2026, the 400 kV system voltages have dropped to 383 kV and the 220 kV system voltages have been reported close to 185 kV. Further, Punjab draws up to 1000 MVAr of reactive power from the ISTS network. Therefore, PSTCL is to take necessary steps for installation of Capacitor Banks of at suitable nodes where low voltages are observed frequently.

Additionally, during off-peak season of 2025-26 network of Punjab experienced high voltages at all voltage levels i.e. 400 kV system voltages reached close to 434 kV and 220 kV system voltages reached close to 240 kV. PSTCL have planned following Bus reactors under intra-state for mitigation of over voltage issues:

Table 1.10: Bus reactors planned under intra-state system by PSTCL

S.No.	Location	Voltage level (kV)	Under Construction	
			No of reactor	MVAR
1	Dhanansu	400 kV	1	125
2	Makhu	400 kV	1	125
3	Nakodar	400 kV	1	125
4	Dhuri	400 kV	1	125
5	Muktsar	400 kV	1	125

6	Behman Jassa Singh	400 kV	1	125
7	Rajpura	400 kV	1	125

(iv) Operational constraints in ISTS:

a) Operational constraints in 400/220 kV ICTs at Inter-State substations in Punjab:

S. No.	Sub-station	Major Constraints	Remedial Solution
1	400/220 kV Jalandhar (PG)	Loadings above N-1 loading limits were observed sometime in 2x315+500 MVA ICTs in June 2026	New 400 kV Wadala Granthian will relieve loading of Jalandhar ICTs
2	400/220 kV Ludhiana (PG)	Loadings above N-1 loading limits were observed in 2x315MVA +3x500 MVA ICTs in June 2026	Loading will be relieved by additional ICT being planned at 400 kV Dhanasu
3	400/220 kV Malerkotla	Loadings above N-1 loading limits were observed in 2x315MVA +1x500MVA ICTs in June 2026	Additional ICT to be planned
4	765/400 kV Moga (PG)	N-1 non-compliance of ICTs was observed most of the time, loading of ICTs is even going upto 2000 MW. During peak demand of J&K, ICTs become N-1 non-compliant due to drawl from these ICTs	The planned updgration of 765 kV Kishenpur-Moga D/c which is currently charged at 400 kV level to be expedited
5	400 kV Amritsar	ICTs are N-1 non-compliant during non-solar hours in summer/paddy season.	New 400 kV Wadala Granthian S/s will relieve loading of ICTs

b) Transmission line constraints

S. No.	Transmission line	Major Constraints	Remedial Solution
1	400 kV Kaithal-Patran D/c line	Loading of line reached N-1 limit sometimes in Q1 of 2026-2027.	Appropriate network augmentation measures, such as reconductoring to be considered.
2	400 kV Rajpura thermal-Rajpura D/c line	Loading of line reached N-1 limit	Additional connectivity to be planned. Split Buses at Rajpura or reconductoring of line to be explored

Chapter-2

Transmission System Requirement by 2030-31

2.1 Load flow studies for preparation of Resource Adequacy of transmission system in Punjab

2.1.1 Scope of Load flow studies:

System studies for the resource adequacy plan for Punjab's InSTS have been carried out using PSSE Software. The studies that have been carried out include the following:

(i) Steady state load flow studies

(ii) Contingency Analysis

(iii) Short Circuit Studies

Peak electricity demand in Punjab occurs in Paddy season during the months of June/July. Hence, for preparation of Resource Adequacy plan of Transmission system in Punjab, all the scenarios i.e. afternoon (solar peak generation scenario), evening (no solar generation scenario) and night (low demand) have been studied for the month of June. Also, the off-peak scenario in winter season has been studied for reactive power management.

The load flow studies have been carried out for two time-frames: 2030-31 and 2035-36 for peak electricity demand scenarios occurring during summer season. To meet the projected electricity demand, augmentation required in both ISTS as well as Intra-State Transmission System has been worked out.

2.1.2 Transmission Planning Guidelines:

(i) Punjab's transmission network has been represented generally at 132 kV and above voltage levels, where loads have been considered incidental on 132 kV or 220 kV level buses.

(ii) Load power factor has been considered within ± 0.95 as per the Central Electricity Authority (Technical Standards for Connectivity to the Grid) (Amendment) Regulations, 2019.

(iii) 'N-1' criterion is generally followed for providing reliable power supply to the consumers.

(iv) Transformation capacity of any single sub-station at 220 kV and 400 kV levels has been considered to be limited to 1000 MVA and 2500 MVA respectively as per the Manual on Transmission Planning Criteria of CEA (2025).

(v) Due to RoW constraints, re-conductoring in the existing 400 kV, 220 and 132 kV lines with higher capacity conductors HTLS (High Temperature Low Sag), having the ampacity more than double of existing ampacity of conductor has been considered.

(vi) The system voltage has been considered within the following limits as per the Manual on Transmission Planning Criteria, 2025:

132 kV	Max 145 kV, Min 122 kV
220 kV	Max 245 kV, Min 198 kV
400 kV	Max 420 kV, Min 380 kV
765 kV	Max 800 kV, Min 728 kV

2.2 Load flow studies for the year 2030-31:

(i) The load flow studies have been carried out for two scenarios:

a) Peak electricity demand scenario (solar hour) during summer season in the month of June and;

b) Non-solar hour scenario during summer season in the month of June and;

c) Off peak (Night) scenario in both winter and summer seasons.

(ii) Peak electricity demand of Punjab in 2030-31 as per revised 20th EPS projections is 19860 MW. However, PSTCL informed that the actual load growth is envisaged to be higher than the EPS projections and accordingly, peak electricity demand of 22000 MW was considered in 2030-31 time-frame for Resource adequacy studies.

(iii) No major Thermal/Hydro/Nuclear generation project addition have been envisaged in Punjab. Only addition in solar generation of about 700 MW is expected by 2027-28.

(iv) For the peak demand scenario of 2030-31, the transmission elements (new lines/reconductoring of the existing lines and new substations/ICT augmentations) already taken up for implementation by PSTCL have been considered.

(v) Under implementation/Planned ISTS Schemes in Punjab to be commissioned by 2030-31 have been considered in the studies, details of which are given below:

Table 2.1: Under implementation/bidding/planned ISTS transmission schemes

S. No.	Transmission scheme	Status
1	Augmentation of Transformation Capacity at 400/220 kV Malerkotla(PG) S/s by 1x500 MVA ICT (4th)	Under Implementation (Timeframe: 2026-27)
2	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-3: 6 GW) [Bikaner complex]: • Siwani – Patran (Indi Grid) 400 kV D/c line (Quad)	Under Implementation (Timeframe: 2027-28)
3	Transmission scheme for evacuation of power from Ratle HEP (850 MW) & Kiru HEP (624 MW):	Under Implementation (Timeframe 2027-28)

	• 400 kV Samba- Jalandhar D/c line (Quad) (only one circuit is to be terminated at Jalandhar utilizing 1 no. of 400 kV vacated line bay at Jalandhar S/s (formed with bypassing of 400 kV Jalandhar – Nakodar line (Quad) at Jalandhar) while second circuit would be connected to bypassed circuit of Jalandhar – Nakodar 400 kV line (Quad)) • Bypassing 400 kV Jalandhar – Nakodar line (Quad) at Jalandhar and connecting it with one of the circuits of Samba-Jalandhar 400 kV D/c line (Quad Moose), thus forming 400 kV Samba –Nakodar (Quad) direct line • Bypassing both ckts of 400 kV Kishenpur – Samba D/c line (Twin) & 400 kV Samba – Jalandhar D/c line (Twin) at Samba and connecting them together to form 400 kV Kishenpur-Jalandhar D/c direct line (Twin)	
4	Transmission scheme for evacuation of power from Luhri Stage-I and Sunni Dam HEP: • Bypass one circuit of the existing Koldam–Ropar/Ludhiana 400 kV D/c line at Koldam and connect it with one circuit of the new Nange–Koldam 400 kV D/c line, thereby forming Nange–Ropar/Ludhiana 400 kV single circuit.	Under Implementation (Timeframe 2029-30)
5	Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-6: 6 GW) (Bikaner Complex): • Establishment of 400/220 kV, 4x500 MVA Mohali GIS S/s at suitable location near Mohali • LILO of one circuit of 400 kV Patiala-Panchkula D/c line at Mohali (Twin HTLS) • 400 kV Panipat - Mohali D/c (Quad Moose) line	Under Bidding (Timeframe 2029-30)
6	Transmission scheme for evacuation of power from Kwar HEP (540 MW), Dulhasti Stage-II HEP (260 MW) & Uri-I Stage-II HEP (240 MW):	Under Planning (Timeframe 2029-30)

	• Upgradation of Moga - Jammu (New 765 kV S/s) 2xS/c line section from 400 kV to 765 kV voltage level (formed after LILO of Kishanpur-Moga at Jammu) • Jammu (765) - Dasuya (PSTCL) 400 kV D/c line • LILO of 400 kV Amritsar - Parboti Pool (Banala) S/c line at Dasuya S/s • Establishment of 3x500 MVA, 400/220 kV Substation at Nawasahar (ISTS) • Dasuya (PSTCL) - Nawasahar 400 kV D/c line	

(vi) Under construction /Planned Intra-State transmission schemes in State of Punjab to be commissioned by 2030-31 have been considered in the studies, details of which are given below:

Table 2.2: Details of under implementation/planned new intra-state sub-stations in Punjab

S.No.	Sub-stations	Total MVA	Status	Timeframe
400 kV level				
1	2x500 MVA, 400/220 kV Wadala Granthian	1000	Planned	2028-29
2	2x500 MVA, 400/220 kV GNDTP Bathinda	1000	Planned	2030-31
3	2x500 MVA, 400/220 kV Dasuya	1000	Planned	2030-31
4	2x500 MVA, 400/220 kV Mohali-1	1000	Planned	2030-31
	Total	**4000**		
220 kV level				
1	2x160 MVA, 220/66 kV Mubarikpur	320	Under Implementation	2026-27
2	2x160 MVA, 220/66 kV Aerocity/IT City	320	Under Implementation	2027-28
3	2x160 MVA, 220/66 kV Giaspura	320	Planned	2028-29

S.No.	Sub-stations	Total MVA	Status	Timeframe
4	2x100 MVA, 220/66 kV Bhadson	200	Under Implementation	2027-28
5	2x100 MVA, 220/132 kV Jandiala Guru	200	Under Implementation	2027-28
6	1x160 MVA, 220/66 kV + 1x100 MVA, 220/66 kV Ajnala	260	Under Implementation	2027-28
7	1x160 MVA, 220/66 kV + 1x100 MVA, 220/66 kV Jhordan	260	Under Implementation	2027-28
8	1x160 MVA, 220/66 kV + 1x100 MVA, 220/66 kV Bhalaiana	260	Under Implementation	2026-27
9	1x160 MVA, 220/66 kV Chitti	160	Under Implementation	2027-28
10	2x100 MVA, 220/66 kV Nawan Pind	200	Under Implementation	2027-28
11	2x160 MVA, 220/66 kV Chourwala	320	Under Implementation	2028-29
12	2x100 MVA, 220/66 kV Dinanagar	200	Planned	2028-29
13	2x160 MVA, 220/66 kV Behak Khaas (Fazilka)	320	Planned	2028-29
14	1x160MVA, 220/66 kV + 1x100 MVA, 220/66 kV Toot	260	Planned	2028-29
15	1x160MVA, 220/66 kV Shri Hargobindpur	160	Planned	2028-29
16	2x160 MVA, 220/66 kV Old Patiala	320	Planned	2030-31
17	2x160 MVA, 220/66 kV AKIC	320	Planned	2030-31
18	1x100MVA, 220/132 kV + 1x100MVA, 220/66 kV Tanda	200	Planned	2027-28
19	2x100 MVA, 220/132 kV Beas	200	Under Implementation	2028-29
20	1x160 MVA, 220/66 kV Jhoke Harihar	160	Planned	2030-31

S.No.	Sub-stations	Total MVA	Status	Timeframe
21	1x160 MVA, 220/66 kV Samadh Bhai (u/g from 132 kV)	160	Planned	2030-31
22	1x160 MVA, 220/66 kV + 1x100 MVA, 220/132 kV, Verka S/s	260	Planned	2030-31
23	1x100 MVA, 220/66 kV + 1x160 MVA, 220/66 kV Guru Har Sahai S/s	260	Planned	2030-31
24	Upgradation of 66 kV Kurali to 2x160 MVA, 220/66 kV S/s	320	Planned	2030-31
	Total	**5960**		

Table 2.3: Under implementation/planned intra-state transmission lines in Punjab

S.No.	Transmission Lines	Line Length (in ckm)	Status	Timeframe
400 kV level				
1	LILO of 400 kV Kurukshetra - Nakodar D/c line at Dhanansu	8	Under Implementation	2026-27
2	LILO of 400 kV Koldam - Ludhiana D/c line at Ropar	16	Under Implementation	2026-27
3	LILO of 400 kV Jalandhar - Samba D/c line at Wadala Granthian	26	Planned	2028-29
4	LILO of 400 kV Talwandi Sabo-Muktsar D/c line at 400 kV GNDTP Bathinda	100	Planned	2030-31
5	LILO of 400 kV Chamera-Jalandhar D/c line at 400kV Dasuya	20	Planned	2030-31
6	LILO of 400 kV Patiala-Nallagarh line at 400 kV Mohali-1 *(Also, Sundar Nagar (ISTS) – Mohali-1 400 kV D/c line is under planning in ISTS)*	112	Planned	2030-31
	Total	**282**		

220 kV level				
1	LILO of 220 kV Mohali-2 - Lalru D/c line at Aerocity	4	Under Bidding	2027-28
2	LILO of 220 kV Mohali-2 - Mubarikpur D/c line at Aerocity	5	Under Bidding	2027-28
3	LILO of 220 kV Ludhiana - Dhandari Kalan line at Giaspura	16	Under Bidding	2027-28
4	LILO of 220 kV Bhaduragarh - Devigarh line at Old Patiala	19	Under Bidding	2028-29
5	LILO of 220 kV Rajpura - Devigarh D/c line at AKIC	15	Under Bidding	2030-31
6	LILO of 220 kV Makhu - Algon D/c line at Toot	7	Under Bidding	2028-29
7	220 kV Wadala Granthian - Hargobindpura D/c line	56	Under Bidding	2028-29
8	LILO of 220 kV Gurdaspur - Sarna line at Dinanagar	8	Under Bidding	2028-29
9	Patiala(PG) - Bhadson D/c line	42	Under Construction	2028-29
10	Bhalwan - Bhawanigarh S/c line	12	Under Construction	2027-28
11	LILO of 220 kV Talwandi Sabo-Mansa D/c line at Maur	20	Under Construction	2026-27
12	Behman Jassa Singh - Talwandi Sabo 220 kV D/c line	9	Under Construction	2026-27
13	Behman Jassa Singh - Mansa & HMEL 220 kV D/c line	6	Commissioned	2026
14	Behman Jassa Singh - GNDTP Bathinda 220 kV D/c line	96	Under Construction	2028-29
15	LILO of 220 kV Rajpura- G1 D/c line at Chourwala	32	Planned	2029-30
16	Faridkot - Kotakpura-II 220 kV S/c line	22	Under Construction	2027-28

17	LILO of 220 kV BBMB Jalandhar Butari - Jaalandhar D/c line at Beas	5	Under Construction	2026-27
18	LILO of 220 kV Butari - Verpal to 220 kV Jandiala Guru	7	Under Construction	2027-28
19	LILO of 220 kV Nakodar - Kartarpur at Chitti	2	Under Construction	2027-28
20	LILO of 220 kV RSD - Sarna at Shahpur Kandi PH-I	1	Under Construction	2026-27
21	LILO of 220 kV RSD - Sarna at Shahpur Kandi PH-II	2	Under Construction	2026-27
22	LILO of 220 kV Fatehgarh Churian - ASR Civil line at Ajnala	31	Under Construction	2027-28
23	LILO of 220 kV Verpal - Wadala Granthian and Verpal Udhoke at Nawanpind	3	Under Construction	2027-28
24	LILO of 220 kV Jalandhar - Dasuya line at Tanda	6	Under Bidding	2027-28
25	Dhanasu-Doraha 220 kV D/c line	44	Under Construction	2027-28
26	LILO of 220 kV Ganguwal - Jamalpur D/c line at Dhanasu	18	Under Construction	2026-27
27	LILO of 220 kV GNDTP Bhatinda - Badal D/c line at Bhalaina	0.3	Planned	2029-30
28	LILO of 220 kV RTP - Kohara D/c line at Ghulal	11	Planned	2028-29
29	LILO of 220 kV Ghulal - Kohara D/c line at Dhanasu	22	Planned	2028-29
30	LILO of 220 kV Pakhowal - Mehalkalan D/c line at Jhordan	16	Planned	2028-29
31	LILO of 220 kV Muktsar - Malout D/c line at Bhalaina	0.3	Planned	2029-30
32	Sehora – She 220 kV S/c line	27	Under Construction	2027-28

33	LILO of 220 kV Rajpura - Mohali D/c line at Banur	8	Under Construction	2027-28
34	Rajpura – Rajpura (400) 220 kV D/c line	6	Under Construction	2027-28
35	LILO of 220 kV Mohali-2 - Derabassi D/c line at Mubarikpur	7	Under Construction	2026-27
36	LILO of 220 kV Ganguwal - Dhanasu D/c line at Jadla	4	Under Bidding	2027-228
37	LILO of 220 kV Muktsar - Ghubaya D/c line at Behak Khass (Fazilka)	30	Planned	2028-29
38	Ghubaya - Guru Har Sahai 220 kV D/c line	70	Planned	2030-31
39	Jhoke Hari Har - Guru Har Sahai 220 kV D/c line	60	Planned	2030-31
40	LILO of 220 kV Baghapurana - Bajakhana D/c line at Samadh Bhai	32	Planned	2030-31
41	Stringing of 2nd ckt. of 220 kV Muktsar-Ghubaya line	38	Planned	2030-31
42	Noormehal - Goraya 220 kV D/c line	34	Planned	2030-31
43	LILO of 220 kV Jalandhar - Jamalpur D/c line at Goraya	1	Planned	2030-31
44	LILO of 220 kV Kanjli - Science City D/c line at Sultanpur	56	Planned	2030-31
45	Hoshiarpur - Dasuya 220 kV D/c line	86	Planned	2030-31
46	Butari - Wadala Granthian 220 kV D/c line	70	Planned	2030-31
47	Stringing of 2nd circuit of 220 kV Malout - Abohar line	30	Planned	2030-31
48	LILO of 220 kV Fatehgarh Churiyan - Wadala Granthian D/c line at Kotli Surat Malhi	34	Planned	2030-31
49	LILO of 220 kV Fatehgarh Churiyan - Civil lines Amritsar D/c line at Majitha	31	Planned	2030-31
50	Khassa - Chogawan 220 kV D/c line	24	Planned	2030-31

51	Naraingarh - Civil lines Amritsar 220 kV S/c line	31.4	Planned	2030-31
52	Naraingarh - Chogawan 220 kV S/c line	18	Planned	2030-31
53	LILO of 220 kV Muktsar - Abohar D/c line at switching station of SAEL	4	Planned	2030-31
54	LILO of 220 kV Amloh - G1 D/c line at Bhadson	28	Planned	2030-31
55	Zirakpur - Mubarikpur 220 kV S/c line	8	Planned	2030-31
56	Zirakpur - Lalru 220 kV S/c line	30	Planned	2030-31
57	Mohali (ISTS) - Aerocity/IT City 220 kV D/c line	30	Planned	2029-30
58	Mohali (ISTS) - Zirakpur 220 kV D/c line	58	Planned	2029-30
59	Mohali (ISTS) - Banur 220 kV S/c line	10	Planned	2029-30
60	Mohali (ISTS) - Mohali-1 (PSTCL) 220 kV S/c line	28	Planned	2029-30
61	Mohali (ISTS) - Rajpura 220 kV D/c line	30	Planned	2029-30
62	Mohali (ISTS) - AKIC 220 kV D/c line	30	Planned	2029-30
63	LILO of 220 kV RTP - Kharar line at Kurali	5	Planned	2030-31
64	LILO of 220 kV Wadala Grnathian - Nawanpind D/c line at Verka	26	Planned	2030-31
	Total	**1522**		

(vii) Under construction /Planned Intra-State ICT augmentations in State of Punjab to be commissioned by 2030-31 have been considered in the studies, details of which are given below:

Table 2.4: ICT augmentation under implementation/planned by PSTCL

S. No.	Substation	Voltage Level (kV)	Existing (MVA)	Augmentation	Net Addition (MVA)	Status	Time frame
400 kV level							
1	Dhanansu	400/220	2x500	1x500	500	Under Bidding	2028-29
				Total	**500**		
220 kV level							

1	Chhajli	220/66	200	1x100→1x160	60	Planned	2030-31
2	Wazirabad	220/66	160	1x160	160	Planned	2030-31
3	GNDTP Bathinda	220/132/66	500	1x160	160	Planned	2030-31
4	Goraya	220/132/66	300	1x100 (220/66 kV)	100	Planned	2030-31
5	Banga (Nawansheher)	220/132/66	260	2x100 (220/66 kV)	100	Planned	2030-31
6	Mandi Gobindgarh-3	220/66	300	1x100→1x160	60	Planned	2030-31
7	Maur	220/66	200	1x100	100	Planned	2030-31
8	Mohali-1	220/66	480	1x160	160	Planned	2030-31
9	Mohali-2	220/66	260	1x100→1x160	60	Planned	2030-31
10	Mehalkalan	220/66	200	1x100	100	Planned	2030-31
11	Moga (Singhawala)	220/132/66	400	1x100	100	Planned	2030-31
12	Gaunsgarh	220/66	260	1x100	100	Planned	2030-31
13	Rehana Jattan	220/66	200	1x100	100	Planned	2030-31
14	Patti	220/66	360	1x100→1x160	60	Planned	2030-31
15	Patran	220/66	300	1x100→1x160	60	Planned	2030-31
17	Sunam	220/66	360	1x100→1x160	60	Planned	2030-31
18	Rajla	220/66	260	1x100→1x160	60	Planned	2030-31
19	Banur	220/66	260	1x100→1x160	60	Planned	2030-31
20	Dhuri	220/66	300	1x100→1x160	60	Planned	2030-31
21	Barnala (Handiaya)	220/66	300	1x100→1x160	60	Planned	2030-31
22	Baghapurana	220/66	200	1x100→1x160	60	Planned	2030-31
23	Ghubaya	220/66	360	1x100→1x160	60	Planned	2030-31
24	Katorewala	220/66	200	1x100→1x160	60	Planned	2030-31
25	Abohar	220/66	200	1x100→1x160	60	Planned	2030-31
26	Himmatpura	220/66	260	1x100→1x160	60	Planned	2030-31
27	Rajpura	220/66	360	1x100→1x160	60	Planned	2030-31

28	Passiana	220/66	200	1x100→1x160	60	Planned	2030-31
29	Kakrala	220/66	200	1x100→1x160	60	Planned	2030-31
30	Noormehal	220/66	200	1x100→1x160	60	Planned	2030-31
31	BBMB Jalandhar	220/66	200	1x100→1x160	60	Planned	2030-31
32	Wadala granthian	220/66	400	1x100→1x160	60	Planned	2030-31
33	Kotli Surat Malhi	220/66	200	1x100→1x160	60	Planned	2030-31
34	Sarna	220/66	400	1x100→1x160	60	Planned	2030-31
35	Bhateri (Bahadurgarh)	220/66	260	1x160	160	Planned	2030-31
36	Kharar	220/66	320	1x160	160	Planned	2030-31
37	Dera bassi	220/66	300	1x100→1x160	60	Planned	2030-31
38	Mandi Gobindgarh-2	220/66	520	1x100→1x160	60	Planned	2030-31
39	Bassi Pathana	220/66	200	1x100→1x160	60	Planned	2030-31
40	Dhanaula	220/66	260	1x100→1x160	60	Planned	2030-31
41	Jamsher	220/66	260	1x100→1x160	60	Planned	2030-31
				Total	**3180**		

Table 2.5: Reconductoring of intra-state transmission lines proposed by PSTCL

S. No.	Transmission line	ckm	Status	Timeframe
220 kV level				
1	220 kV Shahpur Kandi - Sarna S/c line	18	Under Construction	2027-28
132 kV level				
1	LILO of 132 kV Shanan-132 kV Kangra-Pathankot D/c line at Mammon	126	Under Construction	2026-27

2.3 Load flow study results:

Based on the load flow studies, following was observed:

i) The existing, under construction and planned sub-stations by PSTCL till timeframe 2030-31 will relieve the existing constraints in the Intra-state network of Punjab. The existing, under construction and planned sub-stations by PSTCL would be sufficient to cater the demand in the state of Punjab.

(a) On account of increased load scenario by 2030-31 and increased drawl of power from ISTS during peak season some additional augmentation works in the intra-state network may be required to meet demand and to meet N-1 compliance.

Table 2.6: Transformation augmentation works by 2030-31

S. No.	Substation	Voltage Level (kV)	Already Planned/Existing (MVA)	Augmentation	Net Addition (MVA)
400 kV Level					
1	Wadala Granthian	400/220	1x500	1x500 (2nd)	500
2	Dasuya	400/220	2x500	1x500 (3rd)	500
3	Ropar	400/220	2x500	1x500 (3rd)	500
4	Mohali-1 (PSTCL)	400/220	2x500	1x500 (3rd)	500
				Total	**2000**
220 kV Level					
1	Aerocity 2	220/66	2x160	1x160 (3rd)	160
2	Algon	220/66	2x100	2x100→2x160	120
3	Bagha Purana	220/66	1x160 + 1x100	1x100→1x160	60
4	Bajakhana	220/66	2x160	1x160 (3rd)	160
5	Barnala	220/66	3x100	2x100→2x160	120
6	Chhajli	220/66	1x160 +1x100	1x100→1x160	60
7	Nabha	220/66	2x160	1x160 (3rd)	160
8	Gobindgarh	220/66	1x160 + 1x100	1x100→1x160	60
9	Humbran	220/66	2x100 + 1x160	1x100→1x160	60
10	Kakrala	220/66	1x160 + 1x100	1x100→1x160	60
11	Malerkotla	220/66	2x160 + 1x100	1x100→1x160	60
12	Passiana	220/66	1x160 + 1x100	1x100→1x160	60
13	Rajpura	220/66	2x100 + 1x160	1x100→1x160	60
				Total =	**1200**

Table 2.7: Additional lines/interconnections

S. No.	Transmission line	Line length (in ckm)
1	LILO of 2nd Ckt of Sunam - Patran 220 kV D/c line at Bangan	8
2	LILO of Derabassi - Mubarikpur 220 kV D/c line at Panchkula	11
3	LILO of 2nd Ckt of Dhandari Kalan - Jamalpur 220 kV D/c line at Sherpur	4
4	LILO of 2nd Ckt of Mohali - Ropar 220 kV D/c line at Kharar	3
5	LILO of 2nd Ckt of Ablowal - Rajla 220 kV D/c line at Passiana and Reconductoring of Ablowal - Passiana 220 kV Section	6
	Total	**32**

Table 2.8: Reconductoring of existing transmission lines with HTLS conductor

S.No.	Transmission line	Line Length (in ckm)
1	Amritsar - Naraingarh 220 kV D/c line	33
2	Patiala - Bahadurgarh 220 kV D/c line	25
3	Sarna - Dinanagar 220 kV D/c line	38
4	Kakrala - Patran 220 kV D/c line	22

2.4 Short Circuit studies

In the short circuit studies carried out for the year 2030-31, it has been observed that the fault level at various substations is either near or higher than the designed limits. Considering the high fault levels in Punjab, it is recommended to replace the existing equipment with the higher rating equipment. PSTCL may also consider Bus splitting arrangement wherever feasible and found necessary. It is also recommended that all new substations should be planned with higher short circuit capacity, i.e. 80 kA for 400 kV and 63 kA for 220 kV as per the CEA Manual on Transmission Planning Criteria, 2023 which is given below:

The maximum short-circuit level on any new substation bus should not exceed 80% of the rated short circuit capacity of the substation equipment. The 20% margin is intended to take care of the increase in short-circuit levels as the system grows. The rated breaking current capability of switchgear at different voltage levels may be taken as given below:

Voltage Level	Rated Breaking Capacity
765 kV	50 kA / 63 kA
400 kV	63 kA / 80 kA
220 kV	40 kA / 50 kA / 63 kA

2.5 Summary of Intra-State Transmission Network in Punjab by 2030-31

The summary of Transformation capacity (MVA) and transmission lines (ckm) under intra-state transmission system in the state of Punjab by 2030-31 is given below:

Table 2.9: Summary of intra-state transmission system augmentation in Punjab

Intra-State Transmission System / EHV system	400 kV level	220 kV level	Total
Transformation Capacity (MVA):			
Existing Transformation Capacity (MVA)	9890	30080	**39970**
Addition in Transformation Capacity (MVA) by 2030-31	6500	10340	**16840**
Total Transformation Capacity by 2030-31 (MVA)	**16390**	**40420**	**56810**
Transmission Lines (ckm):			
Existing Transmission Lines (ckm)	1688	8220	**9908**
Addition of Transmission Lines by 2030-31(ckm)	282	1554	**1836**
Total transmission lines by 2030-31 (ckm)	**1970**	**9774**	**11744**

Additionally, reconductoring of existing intra-state transmission lines is also to be considered.

Chapter-3

Transmission System addition planned by 2035-36

3.1 Load flow studies for the year 2035-36

(i) The load flow studies have been carried out for the following scenarios:

a) Peak electricity demand scenario during summer/paddy season in the month of June during both solar and non-solar hours and;

b) Off-peak electricity demand scenario during winter season

(ii) Peak electricity demand of Punjab in 2035-36 has been considered as 25 GW based on inputs from PSTCL. This demand is higher than the revised 20th EPS demand projections for the state of Punjab.

(iii) The transmission elements (new lines/reconductoring of the existing lines and new substations/ICT augmentations) planned by PSTCL have been considered. The details are given below:

Table 3.1: Details of planned new intra-state sub-stations in Punjab

S.No.	Sub-station	MVA	Status
765 kV level			
1	3x1500 MVA, 765/400 kV Sultanpur Lodhi	4500	Planned
400 kV level			
1	2x500 MVA, 400/220 kV Sultanpur Lodhi	1000	Planned
2	2x500 MVA, 400/220 kV Ludhiana-2	1000	Planned
3	2x500 MVA, 400/220 kV Bassi Pathana	1000	Planned
220 kV level			
1	2x160 MVA, 220/66 kV Ludhiana New GIS	320	Planned
2	1x160 MVA, 220/66 kV Dhariwal	160	Planned
3	1x160 MVA, 220/66 kV Batala	160	Planned
4	Upgradation of 66 kV Chaherhu 220 kV level with 1x160MVA + 1x100MVA, 220/66 kV ICTs	260	Planned
5	Upgradation of 66 kV Gill Road Ludhiana to 220 kV level with 2x160 MVA, 220/66 kV ICTs	320	Planned
6	Upgradation of 66 kV Bija Chawa to 220 kV level with 2x100MVA, 220/66 kV ICTs	200	Planned

7	Upgradation of 66 kV Bhagta Bhai to 220 kV level with 1x160MVA + 1x100MVA, 220/66 kV ICTs	260	Planned
8	Upgradation of 132kV Ferozeshah to 220 kV level with 100 MVA, 220/132 kV ICT	100	Planned
9	Upgradation of 66 kV Sur Singh to 220 kV level	200	Planned
10	Upgradation of 132 kV IGC Bathinda to 220 kV level	200	Planned
11	Upgradation of 132 kV Kotakpura-1 to 220 kV level	200	Planned
12	Upgradation of 66 kV Lohian Khas to 220 kV level	200	Planned
	Total	**2580**	

Table 3.2: Details of planned intra-state transmission lines in Punjab

S.No.	Transmission line	Line Length (in ckm)	Status
765 kV level			
1	LILO of both of Moga – Jammu-2 765 kV D/c line at Sultanpur Lodhi	30	Planned
400 kV level			
1	LILO of both ckts of Makhu - Nakodar 400 kV D/c line at Sultanpur Lodhi	6	Planned
2	LILO of both ckts of Amritsar - Malerkotla 400 kV D/c line at Sultanpur Lodhi	6	Planned
3	LILO of Malerkotla - Sultanpur 400 kV D/c line at Ludhiana2	68	Planned
4	LILO of Rajpura - Nakodar 400 kV D/c line at Bassi Pathana	4	Planned
	Total	**84**	
220 kV level			
1	LILO of 220 kV Ladowal - Gaunsgarh D/c line at GT Road Ludhiana	28	Planned

2	LILO of 220 kV Nakodar - Hoshiarpur line at Chaheru	12	Planned
3	LILO of 220 kV Nakodar - Rehana-Jattan line at Chaheru	12	Planned
4	Ferozpur Road Ludhiana - Gill Road Ludhiana 220 kV D/c line	16	Planned
5	LILO of one ckt of 220 kV Dhanansu - Doraha D/c line at Bija Chawa	24	Planned
6	LILO of both circuits of 220 kV Himmatpura - GHTP D/c line at Bhagta Bhai	96	Planned
7	LILO of both circuits of 220 kV Patti - Algon Kothi D/c line at Sur Singh	68	Planned
8	LILO of both circuits of 220 kV Behman Jassa Singh-GNDTP D/c line at IGC Bathinda	36	Planned
9	LILO of 220 kV Muktsar - Sandhwan D/c line at Kotakpura-1	12	Planned
10	LILO of 220 kV Ferozpur - Bottianwala D/c line at Ferozshah	10	Planned
11	LILO of 220 kV RTP - Kharar D/c line at Kurali	12	Planned
12	LILO of both circuits of Makhu - Rashiana D/c line at Lohian Khas	52	Planned
13	Shahkot - Lohian Khas 220 kV D/c line	30	Planned
14	LILO of Gurdaspur - Wadala Granthian 220 kV D/c line at Dhariwal	10	Planned
15	LILO of Wadala Granthian - Kotli Surat Malhi 220 kV D/c line at Batala	12	Planned
16	Wadala Granthian - Batala 220 kV D/c line	16	Planned
17	LILO of Sultanpur - Jamsher 220 kV D/c line at Sultanpur Lodhi	10	Planned
18	LILO of Sultanpur - Badshahpur 220 kV D/c line at Sultanpur Lodhi	10	Planned
19	Shahkot - Sultanpur Lodhi 220 kV D/c line	28	Planned
	Total	**494**	

(iv) There is significant variation in the demand of Punjab between Solar and Non-solar hours. Therefore, in order to source cheaper power during solar hour and dispatch it during non-solar the following Battery Energy Storage Systems have been planned by PSPCL:

S.No.	Name of GSS	BESS (MW/MWh)
1	GNDTP	250/500
2	Ablowal	250/500
3	Laltokalan	250/500

3.2 Load Flow Study Results:

Based on the load flow studies, following has been observed:

i) The existing, under construction and planned sub-stations for Punjab by 2035-36 would be required to cater the increasing demand. However, on account of increased drawl of power from ISTS during peak season some additional augmentation works in the intra-state network may be required to meet demand and to meet N-1 compliance.

ii) The following additional ICT augmentations may be required by 2035-36 in addition to the already planned transmission elements:

S. No.	Substation	Voltage Level (kV)	Already Planned/Existing (MVA)	Augmentation	Net Addition (MVA)
765 kV Level					
1	Sultanpur Lodhi	765/400	3x1500	4th ICT	1500
220 kV Level					
1	Civil Line Amritsar	220/66	2x100	2x100→2x160	120
2	Kurali	220/66	2x160	3rd ICT	160
3	Mastewal	220/66	2x100	2x100→2x160	120
4	Mehalkalan	220/66	2x100	3rd ICT	100
5	Rashiana	220/66	2x100	2x100→2x160	120
6	Sultanpur	220/66, 220/132	1x160 + 1x100, 2x100	Additional ICT 160 MVA	160
				Total	**780**

iii) The following additional lines/interconnections or reconductoring of existing lines may be required to meet the Punjab Demand by 2035-36:

S.No.	Transmission line	Line Length (in ckm)
1	LILO of Wadala Granthian - Kotli Suratmalli 220 kV line at Batala and Reconductoring of Batala- Kotli Suratmalli Section	16
2	Ablowal-Patiala 220 kV D/c line	15

iv) No major generation capacity addition is planned as of now in the state of Punjab during 2030-31 to 2035-36 timeframe. In that scenario, in order to meet the growing demand, additional system needs to planned for drawl of power by Punjab from the Northern Grid. Considering this, possibility of HVDC system from RE rich regions of Rajasthan to a suitable landing point near Punjab and Haryana border area may be explored.

v) For voltage regulation during off-peak season, it is recommended that PSTCL may plan bus reactors of suitable capacity at new intra-state sub-stations.

3.3 Summary of Transmission Network in Punjab by 2035-36

The summary of Transformation capacity (MVA) and transmission lines (ckm) under intra-state transmission network in the state of Punjab by 2035-36 is given below:

Table 3.3: Intra-state transmission system in Punjab by 2035-36

Intra-State Transmission System	765 kV level	400 kV level	220 kV level	Total
Transformation Capacity (MVA):				
Transformation Capacity (MVA) by 2030-31	0	16390	40420	**56810**
Addition in Transformation Capacity (MVA)	6000	3000	3360	**12360**
Total Transformation Capacity by 2035-36 (MVA)	**6000**	**19390**	**43780**	**69170**
Transmission Lines (ckm):				
Transmission Lines (ckm) by 2030-31	0	1970	9774	**11744**
Addition of Transmission Lines (ckm)	30	84	525	**639**
Total transmission lines by 2035-36 (ckm)	**30**	**2054**	**10299**	**12383**

Chapter-4

Recommendations

1. Intra-State Transmission system augmentation proposed till 2035-36 in the state of Punjab comprises of 2475 ckm (220 kV and above) of transmission lines and 29200 MVA of transformation capacity. In addition, reconductoring of few existing 220 kV lines with HTLS conductors has also been proposed.
2. All the planned transmission network should be timely implemented and PSTCL should expedite the transmission elements proposed for mitigation of transmission constraints in the state.
3. Action must be initiated by PSTCL for approval of the schemes and subsequent award well in time to ensure timely commissioning of the planned transmission schemes. Some of the planned schemes may be reviewed based on growth of electricity demand.
4. Suitable measures should be taken up by PSTCL for voltage regulation in the intra-state transmission network of Punjab and also to check the high MVAr drawl from ISTS.
5. Projects which are planned for the time frame beyond 2030-31 and 2035-36, may be taken up earlier or later as per the requirement of Discom. Accordingly, the Resource Adequacy study for transmission system in the state may be reviewed in the coming years.

Network Map of Punjab

