**Before**

# UTTARAKHAND ELECTRICITY REGULATORY COMMISSION

**Petition No. 46 of 2025**

**In the Matter of:**

**Application seeking approval for the investment on the project for "Installation of LT Capacitor Banks on Distribution Transformers in the State of Uttarakhand."**

**And**

**In the Matter of:**

Uttarakhand Power Corporation Ltd.,
Victoria Cross Vijeta Gabar Singh Urja Bhawan,
Kanwali Road, Dehradun.

**…Petitioner**

## Coram

**Shri M.L. Prasad** **Chairman**
**Shri Anurag Sharma** **Member (Law)**

**Date of Order: July 28, 2025**

## ORDER

This Order relates to the Petition filed by Uttarakhand Power Corporation Limited (UPCL) (hereinafter referred to as "UPCL" or "the Petitioner" or "the licensee") seeking prior approval of the Commission for Investment on the project for "Installation of LT Capacitor Banks on Distribution Transformers in the State of Uttarakhand."

## Background

2. The Petitioner vide its letter No. 1730/D(O)/UPCL/UERC dated 11.04.2025 filed its Petition for investment approval under the provisions of Clause 11 of Distribution and Retail Supply Licence and Regulation 40 of UERC (Conduct of Business) Regulations, 2014.

3. The Petitioner under 'Facts of the case' has submitted that:

"

(i) *With a view to ensure reliable power supply, improved voltage profile and to meet future load growth, the applicant company has proposed Installation of LT Capacitor Banks on Distribution Transformers in the State of Uttarakhand.* ***The Total Capital cost of the proposed work is 147.11 Cr. (Capital Cost of Installation is Rs. 142.07 Cr, IDC cost is Rs. 5.04 Cr.)*** *for which investment approval is being sought. The estimated cost of the project shall be met out from 70:30 Debt Equity ratio. The Debt portion i.e. 70% shall be met will be met through loan from the M/s REC Ltd. or any other financial institution and Equity portion i.e. 30% by Counter Funding/State Funding. The project is proposed to be implemented on turnkey basis.* ***The duration of the project is 18 months.***

*The details of substations and lines are as follows:*

*With objective to avoid low voltage and power factor issues, this project aims at Installation of LT Capacitor Banks on 76,903 Nos. Distribution Transformers (25 KVA & above excluding 16 KVA and PTW) out of existing total 93,196 Nos. Distribution Transformers in UPCL.*

(ii) *The detailed project report showing examination of an economic technical system together with the outline of the work to be undertaken, the salient features and particulars demonstrating the need for investment alongwith relevant cost benefit analysis is enclosed herewith at* ***Annexure-1****. The work to be undertaken does not have any adverse environmental effect. The estimated cost of the project is* ***Rs. 147.11 Cr. (Capital Cost of Installation is Rs. 142.07 Cr., IDC cost is Rs. 5.04 Cr.)****. The estimated cost of the project shall be met out from 70:30 Debt Equity Ratio. The Debt portion i.e. 70% shall be met through loan from the M/s REC Ltd. or any other financial institution and Equity portion i.e. 30% by Counter Funding/State Funding. Further, a request letter to* ***M/s REC*** *for sanction of the loan has been sent and is enclosed herewith as* ***Annexure-2****. The approval from BoD is enclosed herewith at* ***Annexure-3*** *for your kind perusal."*

4. The Petitioner alongwith its Petition has enclosed certified true copy of 122nd Board of Directors meeting dated 17.03.2025. The resolution passed by BOD states that:-

*"**RESOLVED THAT** approval of the Board be and is hereby accorded for Installation of LT Capacitor Banks on Distribution Transformers (25 KVA & above excluding 16 KVA*

*and PTW DTs) in the State of Uttarakhand for an estimated cost of Rs. 147.11 Cr with provisions as given in the Agenda Proposal.*

| ***Sl. No.*** | ***Item*** | ***Unit*** | ***Qty. (DTs)*** | ***Estimated Cost (Rs. In Crores)*** |
|---|---|---|---|---|
| *1* | *Supply & Installation of LT Capacitor Bank on Distribution Transformers* | *Nos.* | *76,903* | *142.07 Cr.* + *5.04 Cr. (IDC)* = ***Rs. 147.11 Cr.*** |

*'**RESOLVED FURTHER THAT** 70% of the amount shall be met by arranging debt from the Financial Institution.'*

*'**RESOLVED FURTHER THAT** 30% of the amount shall be met by State Government as equity.'*

*'**RESOLVED FURTHER THAT** the Director (Finance), UPCL be and is hereby severally authorized to execute such deeds, documents and other writing as may be necessary or required for the purpose aforesaid.'*

*'**RESOLVED FURTHER THAT** the above proposal shall be subject to investment approval from the Hon'ble UERC."*

5. The Petitioner under 'Relief Sought' has submitted that:

"…

(iii) *Grant approval for process the tender of Installation of LT Capacitor Banks on Distribution Transformers for real time power factor improvement, better voltage profile of the system thereby reducing reactive power losses to the minimum, this will also avoid line losses arising out of extra reactive power flow in the transmission network and provide more stability/strength to the grid. However, the work will be awarded after getting the investment approval from Hon'ble Commission."*

6. The Petitioner in its Petition has submitted the following benefits of the Project:

"

- *Reduction in overloading*
- *Improvement in Power factor*
- *Improvement in voltage profile*
- *Reduction in line losses and DT failure rate*

- *Reduction in capital expenditure*
- *Operational Reliability due to less breakdowns"*

7. On examination of the submissions made in the Petition & DPRs certain deficiencies/infirmities were identified and accordingly, the Commission vide its letter No. 354 dated 22.05.2025 directed the Petitioner to furnish its reply on the following latest by 13.06.2025: -

*"*

1. *On preliminary examination of the Petition, it has been observed that the DPR has been prepared without proper study & specific details pertaining to various capacitor banks to be installed at 76903 distribution transformers across the State. UPCL is required to furnish a detailed justification as to why the aforesaid Petition may not be rejected on the grounds of insufficient information.*

2. *UPCL is required to furnish Distribution Transformer-wise details of capacitor banks installed earlier at LT level under various schemes/plans/projects viz. APDRP, R-APDRP, IPDS and any other schemes/plans/projects etc., alongwith expenditure incurred on the same w.r.t. each scheme/plans/projects.*

3. *UPCL is required to furnish Distribution Transformer-wise existing capacitor banks installed in the UPCL's network in following format:*

| *Name of DT with its location* | *Name of 33/11 kV S/s and 11 kV feeder from which DT is connected* | *Rating of installed transformer (in KVA)* | *Rating of capacitor bank (in kVAr)* | *Year of installation of Capacitor Bank* | *Type of Capacitor bank (Fixed/Switched/ manual/ automatic)* | *Details of Harmonic filters* | *Present condition (working/ not working)* |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

*Further, UPCL is required to furnish LT capacitor bank failure rate for last 05 years.*

4. *UPCL is required to furnish data sheet of each rating of capacitor bank installed and proposed in its network alongwith details of cable size used for different rating of capacitor banks. Further, UPCL is required to confirm the average life of LT capacitor banks.*

5. *UPCL is required to furnish cable sizing calculation for different rating of capacitor banks proposed in its instant Petition.*

6. *UPCL is required to confirm whether the AMC of the project has been considered in the instant project cost or not and accordingly substantiate its submission alongwith bifurcation of the same.*

7. *UPCL is required to submit:-*

   (a) *General arrangement Diagram of proposed capacitor banks depicting pole, mounting structure, harmonic filter, size of the cable, protective devices etc.*

   (b) *General arrangement drawing of proposed capacitor banks at locations where plinth mounted transformers are installed.*

   (c) *Connection diagram of 3 phase LT capacitor bank depicting its connection at star side of the distribution transformer.*

   (d) *UPCL is required to furnish activity-wise bar chart indicating the schedule of the instant project.*

8. *Regulations 3.1.2 'Reactive compensation and Harmonics' of UERC (Distribution Code) Regulations, 2018 mandates the determination of size and location of the capacitor installations using appropriate computer software, with reliable field data. In this regard, UPCL is required to submit the latest reliable field data that has been considered for preparation of the instant proposal.*

9. *UPCL is required to confirm following:-*

   (a) *whether the proposed capacitor banks are automatic/manual.*

   (b) *Regarding the switching mechanism of the proposed capacitor banks in its instant Petition.*

   (c) *Details of protection philosophy adopted against the over voltage protection at LT level.*

10. *UPCL in its instant proposal has considered the following charges:*

   (i) *Overhead & business margin of supply & installation cost: 15%*

   (ii) *Contingency charges: 3%*

   (iii) *Centage charges: 2.5%*

   (iv) *Bank Guarantees, Interest on advance & working capital of supply & installation cost: 2%*

*In this regard, UPCL is required to justify the reasons for considering the aforesaid heads of charges/cost alongwith their specified percentages. Further, confirm whether the additional cost impact of 5 years defect liability period has been covered in the instant Petition. If yes, furnish the spread/break-up of the expenses during the defect liability period.*

11. *UPCL is required to furnish the copy of approval received from M/s REC Ltd. for funding of instant project.*

12. *UPCL is required to submit the copy of 'Stock Issue Rates of March, 2023', 'MoM dated 21.06.2024' & 'OM no. 746 dated 01.02.2025' as mentioned at page no. 6 of its DPR under the heading 'estimate for supply & installation of LT capacitor bank' but not submitted along with its proposal.*

13. *UPCL is required to submit the rating-wise details of distribution transformer where the installation of capacitor banks has been proposed in the following format [in hard and soft copy (excel format)].*

| ***Name of DT with its location*** | ***Name of 33/11 kV S/s and 11 kV feeder from which DT is connected*** | ***Rating of installed transformer (in KVA)*** | ***Maximum load/average load on the transformer in kVA in last 01 year*** | ***Average power factor*** | ***Proposed rating of capacitor bank (in kVAr)*** | ***Power factor post installation of capacitor bank*** | ***Reduction in load post installation of capacitor bank (kVA)*** | ***Estimated annual saving in KWh*** |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

14. *UPCL is required to submit the reason for not proposing the said works under 'Distribution infrastructure works/system improvement program' under the RDSS project wherein 90% grant was available from the MoP, GoI. Further, UPCL is required to confirm whether loss reduction proposed after implementation of the instant project were envisaged in the loss reduction targets in RDSS project or not.*

    *Furthermore, UPCL is required to furnish the details of the efforts taken by it for funding the instant project through the grant/soft loan available under various centrally funded schemes of MoP, GoI for distribution system improvement programs.*

15. *UPCL is required to confirm regarding the operational philosophy of the proposed capacitor banks in sync with already installed/yet to be installed capacitor banks at*

*33/11 kV Substations and large scale solar power plants integrated with the grid. Further, UPCL is required to confirm how the ill effects of overcompensation and power quality would be addressed in case the voltage at LT level goes beyond the permissible limits.*

16. *With regard to the payback calculation/savings computation furnished along with the Petition, it has been observed that the savings from the project has been computed considering total annual consumption of 13870 MUs. In this context, UPCL is required to furnish the LT sales data for FY 2024-25. Further, UPCL is required to furnish the basis of considering the total connected load of UPCL as 8468 MW and average power factor of UPCL as 0.83. It appears that the computation of the savings and the payback period calculation has not been done after due diligence study as the same has been computed purely based on assumptions. In fact, the connected load at LT level, consumption at LT level has been assumed contrary to the data provided in CS-3/CS-4 i.e. commercial diary data.*

*UPCL is required to clarify in this regard."*

8. In compliance to the above observations of the Commission, Petitioner vide its letter No. 2521/D(O)/UPCL/UERC dated **02.06.2025** submitted its reply as mentioned below: -

"

1. *The project was envisaged based on the benefits achieved by installing 11KV APFC capacitor banks installed at various 33/11KV Substations. Detailed study of existing distribution transformers of various capacities was carried out and it was found that there are total 93196 nos. DTs in UPCL out of which total 76903 nos. DTs of capacities 25 KVA & above (excluding 16 KVA DTs & PTW DTs) have been considered for the proposed project. The overall power factor of UPCL is 0.83 (data sheet attached as **annex-1**) which is expected to improve to 0.86 after installation of 11 KV APFC panels being installed under the separate project. Similarly, after installation of LT Capacitors under the proposed project, the power factor is expected to further improve to 0.90 (calculation sheet attached **annex-2**). Thus, the petition was prepared based on the existing data of UPCL and after*

*detailed study of the same. Hence, Hon'ble Commission is kindly requested to accept the petition.*

2. *Earlier, during 2004-05 LT capacitor banks were installed in UPCL under APDRP scheme and later during 2012-13 & 2013-14, total 3335 nos. LT capacitor banks were installed under RAPDRP Part-B scheme. The details with expenditure are enclosed as* ***annex-3****.*

3. *Previously LT capacitor banks were installed during 2012-13 & 2013-14, i.e. more than 10 years back with defect liability period of 3 years. At present no LT capacitor bank is available in UPCL's network.*

4. *The technical specifications (****annex-4****) and data sheet of capacitor bank and cable size used for different rating capacitor banks are as follows:*

| *Sr No* | *Capacitor Rating* | *Rated current of capacitor (A)* | *Current at 1.3* Rated Current* | *Cable cross section selected* | *Current capacity of cable @70°C* | *Is Current capacity higher than 1.3*Rated current* |
|---|---|---|---|---|---|---|
| *1* | *5 KVAr 440V* | *6.6* | *8.58* | *1.5 Sq mm* | *14* | *Yes* |
| *2* | *10 KVAr 440V* | *13.1* | *17.03* | *4 Sq mm* | *26* | *Yes* |
| *3* | *15 KVAr 440V* | *19.7* | *25.61* | *6 Sq mm* | *33* | *Yes* |
| *4* | *20 KVAr 440V* | *26.2* | *34.06* | *10 Sq mm* | *45* | *Yes* |

**Considering the current at 1.3 times the rated current, the cable cross section has been selected. The average life of LT capacitor banks shall be 1,30,000 hours.*

5. *As above at point no. 4.*

6. *No AMC has been proposed in the project. In place of it, to ensure better quality and operational reliability, defect liability period of 5 years has been proposed under the project. The cost of the same is included in the instant petition.*

7. *The desired information is as follows:*

*General arrangement diagram is attached as* ***annex-5***

*There is no harmonic filter.*

*Size of cable as mentioned at point no. 4 & 5 above.*

*Protective device etc. as follows:*

i. *Capacitor unit shall be provided with directly connected discharge device metal oxide varistors (MOV) or resistors of suitable energy handling*

*capacity and as per IS: 13340 (Part 1 & 2):2012 for self-healing capacitors. It should be ensured that there must be no switch, fuse or any other isolating device between the capacitor unit and the discharge device.*

ii. *Capacitor shall comply with the relevant general safety regulations for power installation as per Indian Electricity Rules 1956. The capacitor units shall be provided with a suitable earth terminal clearly marked so that it will be connected by the worker to the system earth.*

iii. *The protective cap and terminal block should entirely eliminate hazards increase of accidental contact.*

*Activity wise bar-chart indicating the schedule of instant project is attached as* ***annex-6****.*

8. *The copy of field data is enclosed as* ***annex-1****.*

9. *The desired information is as follows:*

*The proposed capacitor banks are fixed type (rating selected maximum 20% of DT capacity) to minimize the leading condition.*

***PERMISSIBLE OVER LOADS***

*The maximum permissible over loads shall not exceed anyone of the limits given in (i) and (ii) below as conforming to IS: 13340 (Part 1 & 2):2012.*

a) ***Voltage:*** *The permissible overloads shall not exceed limits-set by IS: 13340 (Part 1 & 2):2012 for self-healing type capacitors. Capacitors shall be suitable for prolonged operation at RMS voltage between terminals not exceeding 1.1 times the rated voltage.*

b) ***Current:*** *Capacitor units shall be suitable for continuous operation at RMS Line current 1.3 times the current occurs at rated sinusoidal voltage and rated frequency excluding transients. As per IS:13340 (Part 1 & 2):2012 for self-healing type capacitors.*

c) ***Inrush Current:*** *Should be 300 times the nominal current.*

***SAFETY REQUIREMENT***

a). *Capacitor unit shall be provided with directly connected discharge device metal oxide varistors (MOV) or resistors of suitable energy handling*

*capacity and as per IS: 13340 (Part 1 & 2):2012 for self-healing capacitors. It should be ensured that there must be no switch, fuse or any other isolating device between the capacitor unit and the discharge device.*

b). *Capacitor shall comply with the relevant general safety regulations for power installation as per Indian Electricity Rules 1956. The capacitor units shall be provided with a suitable earth terminal clearly marked so that it will be connected by the worker to the system earth.*

c). *The protective cap and terminal block should entirely eliminate hazards increase of accidental contact.*

10. *The estimation has been done based on the stock issue rates (**annex-7**), MOM dated 21.06.2024 & OM No. 746 dated 01.02.2025 (**annex- 8 & 9**) for considering the overhead & business margin, contingency charges, centage charges, bank guarantees, interest on advance & working capital of supply & installation cost.*

11. *Copy of approval from M/s REC Ltd. for funding of instant project is enclosed as **annex-10**.*

12. *The copies of said Stock issue rates 2023, MOM dated 21.06.2024 & OM no. 746 dated 01.02.2025 is enclosed as above.*

13. *All the distribution transformers except 16 KVA & PTW have been considered in the instant proposal. Total 76903 no. DTs have been considered under the proposal. At present there is no monitoring mechanism at DT level to compile the whole data in desired format, though it is being developed under smart metering project. However, the available data is being attached as **annex-11.***

14. *The project was to be proposed under RDSS modernization plan. But regarding DPR of modernization works under RDSS, there has been no correspondence from MOP/REC etc. till date. Further, the sunset clause of RDSS scheme is upto March'26. Hence, the chances of getting the proposal approved under RDSS are minimal and thus the instant project has been proposed separately.*

15. *UPCL has installed / installing 11 KV capacitor banks at 33/11 KV substations which are automatic in nature and switching mechanism is based on power factor. Proposed LT capacitors are of approximately 20% DT rating only. Considering power factor to 0.85 approx., there will be requirement of approx. 52% out of which*

*20% shall be met by LT capacitor and balance by 11 KV APFC panel. Further, as per provisions of the technical specifications, the permissible overloads shall not exceed limits-set by IS: 13340 (Part 1 & 2):2012 for self-healing type capacitors. Capacitors shall be suitable for prolonged operation at RMS voltage between terminals not exceeding 1.1 times the rated voltage.*

16. *LT Sales data for FY 2024-25 (up to Jan-25) is enclosed as **annex-12**. Total connected load of UPCL as 8468 MW was taken from the commercial data of FY 2023-24 (**annex-13**). Similarly, average power factor was taken from the data as on 31.12.2024 enclosed as annex-1 above. Based on the given data, the calculations have been done and payback period have been calculated accordingly."*

9. On examination of the Petitioner's reply dated 02.06.2025, the Commission observed certain observations/requirement of additional information in its submission and the Commission vide its letter No. 421 dated 06.06.2025 directed the Petitioner to furnish its compliance on the below mentioned points: -

"

1. *With regard to the deficiency no. 1, the Commission had raised observation regarding proper study and specific details pertaining to various capacitor banks to be installed at 76903 DTs across the State and directed it to furnish detailed justification. However, UPCL instead of furnishing the DT-wise proposed capacitor banks details has submitted a justification based on assumption and considering average power factor which is technically incorrect. The requirement of capacity of capacitor bank at each DT needs to be specifically computed based on factors namely kVA rating, maximum load, voltage profile, type of load (capacitive/inductive), location of transformer in the 11 kV network, space availability etc. and the same cannot be generalized as done by UPCL. UPCL is required to furnish detailed study report considering the aforesaid factors.*

2. *With regard to the deficiency no. 2, UPCL has not furnished details of capacitor banks installed during FY 2004-05. Further, the information submitted against the capacitor bank installed during FY 2012-13 & FY 2013-14 is incomplete as UPCL was categorically directed to furnish DT-wise details of capacitor bank installed earlier. In this regard, UPCL is required to furnish the desired information.*

*Further, UPCL is required to submit the year-wise benefit realized post installation of LT capacitor banks under APDRP & R-APDRP scheme.*

3. *With regard to the deficiency no. 3, UPCL has mentioned that no LT capacitor bank is available in its network, however, it has submitted that LT capacitor banks were installed in FY 2004-05, 2012-13 & FY 2013-14. In this regard, UPCL is required to submit the desired information in the prescribed format. Moreover, UPCL has not furnished LT capacitor bank failure rate for last 05 years, UPCL is required to furnish the same.*

4. *With regard to the deficiency no. 4, UPCL has not submitted the desired information for all the proposed capacity of capacitor bank and existing capacitor bank. UPCL is required to submit the same. It has been observed that as per the GTP submitted the inrush current has been mentioned 300xIn. UPCL is required to confirm regarding the same and also confirm that the inrush current consideration has been done while proposing the cable sizing calculation for the different ratings of LT capacitor banks.*

5. *With regard to the deficiency no. 5, UPCL has not submitted the desired information for all the proposed capacity of capacitor bank. UPCL is required to submit the same.*

6. *With regard to the deficiency no. 7, following observation has been observed:-*

   - *With regard to the deficiency no. 7 a, the diagram submitted is not legible.*
   - *With regard to the deficiency no. 7 b, information not submitted.*
   - *With regard to the deficiency no. 7 c, information not submitted.*

   *In this regard, UPCL is required to submit the desired legible complete information.*

7. *With regard to the deficiency no. 8, the requirement of capacity of capacitor bank at each DT needs to be specifically computed based on factors namely kVA rating, maximum load, voltage profile, type of load (capacitive/inductive), location of transformer in the 11 kV network, space availability etc. and the same cannot be generalized as done by UPCL. UPCL is required to submit reliable field data for each DTs where LT capacitor banks has been proposed.*

8. *With regard to the deficiency no. 9, UPCL has mentioned inrush current of 300 times the normal current. In this regard, UPCL is required to confirm regarding*

*the charging time for the LT capacitor bank and confirm that the cable sizing and protective devices have been suitably designed for withstanding the aforesaid inrush current for the desired charging time for the different ratings of proposed LT capacitor banks.*

9. *With regard to the deficiency no. 10, UPCL has not submitted the details of spread/break-up of the expense during the defect liability period. UPCL is required to furnish the same.*

10. *With regard to the deficiency no. 11, UPCL at annexure-x of its submission has furnished a letter from REC specifying pre-commitment conditions:-*

    - *UPCL shall undertake to ensure realization of subsidy till Q-4 FY 2024-25.*
    - *UPCL shall undertake to ensure to comply with a ACS-ARR gap trajectory as notified from time to time.*
    - *UPCL shall undertake to ensure to comply with APN norms (including modifications, if any) in respect of installation of pre-paid meters by UPCL in government offices.*

    *UPCL is required to furnish factual position w.r.t. the aforesaid pre-commitment conditions.*

11. *With regard to the deficiency no. 13, UPCL has not submitted the desired specific information in the prescribed format. In this regard, UPCL is required to submit the desired information in the prescribed format duly validating it with its field data.*

12. *With regard to the deficiency no. 14, UPCL is required to submit all the correspondence made with MoP/REC with regard to sanction of the instant proposal under modernization works of RDSS scheme. Further, UPCL is required to submit the present status of the works sanctioned under the RDSS scheme, its expected completion date and timeline as per the RDSS guideline.*

13. *With regard to the deficiency no. 15, UPCL is required to submit the basis for considering requirement of 52% KVAr. Further, UPCL is required to submit the detailed write-up along with the computation for substantiating its submission.*

14. *With regard to the deficiency no. 16, it is observed that the loss reduction envisaged in the computation should be only of technical nature however, UPCL has*

*considered total T&D losses as 13.89% in its payback period computation which appears to be on higher side. UPCL is required to consider pragmatic T&D loss value in its computation of payback period and submit the basis for the same.*

*Further, UPCL is required to resubmit payback calculation/savings computations considering the sales and connected load at LT level only as UPCL has considered total annual consumption of 13870 MUs and connected load of 8468 MW alongwith pragmatic value of T&D losses in its computations."*

10. In compliance to the Commission's letter dated 06.06.2025, the Petitioner vide its letter No. 2783/D(O)/UPCL/UERC/Capacitor Bank dated 16.06.2025 submitted its reply as mentioned below: -

"

***Point. no. 1:***

*The project was envisaged using the data of FMS system of RAPDRP. The feeder wise power factor was taken as minimum, maximum and average for whole one year. The average power factor was 0.83. Calculations were made to predict the savings on average power factor for whole network. After installation of 11 KV APFC panels, 387 MVAr shall be injected into the network which will increase the average power factor of the system to 0.86 (calculation sheet attached). Further 886 MVAr shall be injected into the network after installation of LT capacitors at LT circuits of DTRs on pole etc., which will further improve the average power factor of whole network to 0.90 thereby reducing the line losses, improving the voltage profile etc. of the whole system.*

*It is submitted that out of total 93196 nos. DTs in UPCL, 76903 nos. DT's LT circuits (excluding PTW DTs & 16 KVA DT's LT circuits) have been considered for the proposed project.*

*As submitted earlier, there is no monitoring mechanism available at present at DT level to compile the whole data (such as DT name, location, voltage profile, maximum load, power factor etc.) in desired format, though it is being developed under smart metering project which is under progress. The possible way out was to gather PFs of corresponding 11 KV Feeders using FMS system for whole one year.*

***Point no. 2 & 3:*** *During 2004-05, 13474 nos. LT capacitor banks were installed under APDRP scheme and later during 2012-13 & 2013-14, total 3335 nos. LT capacitor banks*

*were installed under RAPDRP Part-B scheme. The details alongwith expenditure are enclosed as* ***annex-1 & annex-2****. The APDRP work was executed approx. 20 years earlier and RAPDRP works approx. 12 years earlier. The life of LT capacitor is approx. 10 years. As submitted earlier, no LT capacitor is available in UPCL's network at present. Hence, the desired data in prescribed format, details of benefit realized and failure rate is not available.*

***Point no. 4 & 5:*** *Proposed capacity of Capacitors (DTR wise) is as under:*

| *S. No.* | *Item Description* |
|---|---|
| *1* | *LT Shunt Capacitors 440V 5 KVAr 3 Phase 50 Hz, IP65 with fault indication (for 25 KVA Transformers).* |
| *2* | *LT Shunt Capacitors 440V 10 KVAr 3 Phase 50 Hz, IP65 with fault indication. (for 63 KVA Transformers).* |
| *3* | *LT Shunt Capacitors 440V 15 KVAr 3 Phase 50 Hz, IP65 with fault indication. (for 100 KVA Transformer).* |
| *4* | *LT Shunt Capacitors 440V 15x2 KVAr 3 Phase 50 Hz, IP65 with fault indication. (for 160 KVA Transformer)* |
| *5* | *LT Shunt Capacitors 440V 15x2+20 = 50 KVAr 3 Phase 50 Hz, IP65 with fault indication. (for 250 KVA Transformer)* |
| *6* | *LT Shunt Capacitors 440V 20x4 = 80 KVAr 3 Phase 50 Hz, IP65 with fault indication. (for 400 KVA Transformer)* |
| *7* | *LT Shunt Capacitors 440V 20x5 = 100 KVAr 3 Phase 50 Hz, IP65 with fault indication. (for 500 KVA Transformer)* |
| *8* | *LT Shunt Capacitors 440V 20x6 = 120 KVAr 3 Phase 50 Hz, IP65 with fault indication. (for 630 KVA Transformer)* |
| *9* | *LT Shunt Capacitors 440V 20x8 = 160 KVAr 3 Phase 50 Hz, IP65 with fault indication. (for 800 KVA Transformer)* |
| *10* | *LT Shunt Capacitors 440V 20x10 = 200 KVAr 3 Phase 50 Hz, IP65 with fault indication. (for 1000 KVA Transformer)* |

*It is to mention that inrush current of capacitors exists at the time of switching on & off of LT capacitors. The LT capacitors are intended to be permanently connected in LT network, hence ideally there will not be switching & thus there will not be any inrush current, however inrush current will exist at the time of input supply off & on situation and even if inrush current exists, that will be for micro seconds only thus not affecting it while deciding the cable cross section. However, cable cross section has been kept as almost 2 times of rated current in order to safeguard additional current in lieu of voltage increase, if any.*

***Point no. 6:***

*7a) The LT capacitors shall be installed as shunt capacitors as follows:*

1. *First priority shall be given to install LT shunt capacitor directly on LT lines (to minimize any nuisance at ground level). Diagram is attached as* ***annex-3***

2. *If LT lines are not approachable, then the capacitors shall be installed on distribution boxes as depicted in diagram attached as* ***annex-4***

3. *For smaller rating of Transformer (particularly 25 KVA), we shall connect capacitors on DT bushing through PG/bimetallic connector* ***(annex-5).***

*7b) For plinth mounted transformers: Capacitor shall be installed on LT lines.*

*7c) As the LT capacitors are 3 phase internal delta connection type – hence any of the wires output of Capacitors can be connected as RYB on LT lines*

***Point no. 7:***

*As submitted above, there is no monitoring mechanism available at present at DT level to compile the whole data (such as DT name, location, voltage profile, maximum load, power factor etc.) in desired format, though it is being developed under smart metering project which is under progress.*

***Point no. 8:***

*Inrush handling capacity as 300 times of Nominal current is one of the features of capacitors to make it robust – usually inrush current lies in between 50-100 times of rated current at the time of switching on & off of Capacitors in fixed operation. However, as explained at point no. 4 above, the LT capacitors are intended to be permanently connected in LT network, hence ideally there will not be switching & thus there will not be any inrush current, however inrush current will exist at the time of input supply off & on situation and even if inrush current exists, that will be for micro seconds only thus not affecting it while deciding the cable cross section. However, cable cross section has been kept as almost 2 times of rated current in order to safeguard additional current in lieu of voltage increase, if any.*

***Point no. 9:***

*The defect liability period of the project has been kept 5 years in place of general guarantee period of one year. Hence, on account of extra four years guarantee, additional 4% hike in total cost has been loaded in the estimation.*

***Point. no. 10:***

*The loan has been sanctioned from M/s REC. The terms & conditions for executing the agreement with M/s REC shall be put up for approval in upcoming BOD meeting of UPCL.*

***Point no. 11:***

*As submitted above, there is no monitoring mechanism available at present at DT level to compile the whole data (such as DT name, location, voltage profile, maximum load, power factor etc.) in desired format, though it is being developed under smart metering project which is under progress.*

***Point no. 12:***

*The draft DPR was prepared but no official communication or instructions for submission of Modernization DPR under RDSS were made by MOP GOI. Hence, the DPR was not sent to MOP GOI.*

***Point no. 13:***

*Below mentioned is the calculation sheet of deriving capacitors requirement*

**Calculation of KVAr required to maintain Unity Power factor in system**

Considering Distribution Power Factor as 0.85 without Capacitor,

& Maximum loading of 80% on Transformer of rating 100 KVA.

$$KVAr\ Required = P \times (\tan(\cos^{-1}\varphi_1) - \tan(\cos^{-1}\varphi_2))$$
$$= (100 \times 0.8) \times 0.85 \times (\tan(\cos^{-1} 0.85) - \tan(\cos^{-1} 1)$$
$$= 42.14\ KVAr \text{ Or,}$$

***About 40% to 42% of KVA rating Of Transformer***

*Where,*

$P - Peak\ Load\ in\ KW$

$\varphi_1 - Initial\ Power\ facotr\ \ (0.85\ in\ this\ case)$

$\varphi_2 - Desired\ Power\ factor\ (1\ in\ this\ case)$

*Similarly, UPCL had average power factor as 0.83.*

*With the similar calculation requirement comes out to be 44.48% of KVA rating of Transformer.*

*However, at 11 KV Network, UPCL is installing/installed 11 KV APFC capacitor bank with following capacitor capacity as follows.*

1. *For 3.15 MVA transformer – 1200 KVAR (38%)*
2. *For 5 MVA Transformer – 1800 KVAR (36%)*
3. *For 8 MVA transformer – 2400 KVAR (30%)*
4. *For 10 MVA Transformer- 3000 KVAR (30%)*
5. *For 12.5 MVA transformer – 4800 KVAR (38%)*

*Average compensation at 11 KV side is 32-34% + LT side recommended as 20% and thus total comes out to be 52-54%.*

*As per general electrical practices, to ensure optimal LT lines loss reduction and also to prevent DT overloading, capacitor should be installed at LT network.*

*Hence approx. 20% KVAR capacity shall be injected at LT network and remaining approx. 22-24% KVAR capacity shall be injected through APFC capacitor bank at 11 KV side.*

*Remaining approx. 10% KVAR capacity shall be additionally available at 11 KV side to meet redundancy in case capacitor gets derated /failed during operation.*

*At present calculation has been done considering maximum loading as 80%, and base power factor as 0.83, however loading is increasing day by day and also due to increased electronics load such as LED bulbs (having PF as low as 0.6) and battery charging infrastructure (having poor power factor), the average power factor is bound to decrease further.*

***Point no. 14:***

*As the impact of improved power factor will be on whole network, the calculations were made based on the data of whole network and not only the LT network. Further, the T&D loss was considered @ 13.89% in the submitted payback calculations. If the T&D loss is considered @ 13.25% which is approved by Hon'ble UERC in tariff order, there is minor reduction in calculated savings and the payback period almost remains same i.e. 3 years 7 months.*

*Hon'ble Commission is therefore humbly requested to kindly accord the approval for investment for aforesaid project."*

11. On examination of Petitioner's reply dated 16.06.2025, the Commission observed certain observations/requirement of additional information in its submission and

the Commission vide its letter No. 513 dated 20.06.2025 directed the Petitioner to furnish its compliance on the below mentioned points: -

"

1. *With regard to the deficiency no. 1, 7 & 11, UPCL stating the reason of not having monitoring mechanism at DT level, has not submitted proper study and specific details pertaining to various capacitor banks at each DT specifically computed based on factors namely kVA rating, maximum load, voltage profile, type of load (capacitive/inductive), location of transformer in the 11 kV network, space availability etc. In this regard, UPCL is required to submit the information in the following format pertaining to the Smart Meter installed at distribution transformers under RDSS scheme:-*

| Name of DT with its location | Name of 33/11 kV S/s and 11 kV feeder from which DT is connected | Rating of installed DT (in KVA) | Date of installation of Smart Meter in DT | Load/consumption on DT since installation of Smart Meter | | | Average power factor recorded in Smart Meter | Proposed rating of capacitor bank (in kVAr) | Projected Power factor post installation of capacitor bank | Anticipated Reduction in load post installation of capacitor bank (kVA) | Estimated annual saving in kWh |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Max load (kVA) | Consumption | | | | | | |
| | | | | | kWh | kVAh | | | | | |

2. *With regard to the deficiency no. 2 & 3, UPCL is required to submit the information in the following format pertaining to LT capacitor banks installed in DTs under R-APDRP which are now not available in UPCL networks.*

| Name of DT with its location | Name of 33/11 kV S/s and 11 kV feeder from which DT is connected | Rating of installed DT (in KVA) | Rating of capacitor bank (in kVAr) | Year of installation of Capacitor Bank | Type of Capacitor bank (Fixed/ Switched/ manual/ automatic) | Details of Harmonic filters | Present condition (working/ not working) | Month & Year on which the capacitor bank stopped working/ not available | Month & Year of the decapitalization in books |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

*Further, UPCL is required to submit the year-wise benefits realized and failure rate of the aforesaid capacitor banks till the date it stopped working/not available in UPCL network.*

3. *With regard to the deficiency no. 4 & 5, UPCL has not confirmed that the inrush current has been considered in its cable sizing calculation and has also not furnished cable sizing calculation for different rating of capacitor banks proposed in its instant Petition. In this regard, UPCL is required to submit the following:*

(i) *Cable sizing calculation of different rating of capacitor banks installed under R-APDRP.*

(ii) *Cable sizing calculation of different rating of capacitor banks proposed in the instant Petition with justification for considering the various design parameter considerations.*

4. *With regard to the deficiency no. 14, UPCL has not submitted the desired information. In this regard, UPCL is required to submit payback calculation/savings computations considering the sales and connected load corresponding to the LT consumers intended to be served/connected to the proposed LT capacitor banks only. UPCL has considered total annual consumption of 13870 MUs and connected load of 8468 MW which is on the very higher side.*

*UPCL is required to recompute its payback period calculation/saving computation considering the pragmatic values of sales, connected load, Technical losses and inherent load losses of the fixed LT capacitor banks in the system and submit the basis for the same."*

12. In compliance to the Commission's letter dated 20.06.2025, the Petitioner vide its letter No. 3178/D(O)/UPCL/UERC/C-4 dated 30.06.2025 submitted its reply as mentioned below: -

"

***Point no.1:*** *As the DT wise data was not available, the calculations were done by considering average power factor of one complete year (from 01.01.2024 to 31.12.2024) received from the FMS data of 686 feeders through RT-DAS System. Such data provided reliable power factor of the whole network by accounting seasonal and regional variations of the State. Seasonal variations can significantly impact power factor due to changes in load patterns, industrial and commercial activities, and agricultural loads. Additionally, regional effects such as differences in load characteristics, climate, and economic activities also influence power factor.*

*However, as submitted earlier, Smart metering project is under progress and data of few DTs has been fetched during last two months. Sample list from data of DT meters for Garhwal and Kumaon zone is attached as* ***Annexure-A****. In the sample data of Garhwal region of 205 nos. DTs average PF is less than 0.85 further there are 79 no. DTs having PF less than 0.70. In the sample data of Kumaon region of 84 no. DTs average PF is less*

*than 0.83 further there are 59 no. DTs having average PF less than 0.8. Although the data is too small and short term that it does not cover all the seasonal and regional variations of the whole network but it clearly indicates that there is need of power factor improvement.*

***Point no. 2:*** *As submitted earlier, the data in desired format is not available.*

***Point no. 3:*** *As per IS clauses applicable for Low Voltage shunt capacitors as under:*

***IS 13340 (Part 1): 2012***

***IEC 60831-1:2002***

***Clause 21. Maximum permissible current***

*Capacitor units shall be suitable for continuous operation at an r.m.s. line current of 1.3 times the current that occurs at rated sinusoidal voltage and rated frequency, excluding transients. Taking into account the capacitance tolerances of 1.15 $C_N$, the maximum current can reach 1.5 $I_N$.*

***Clause 34. Switching and protective devices and connections***

*The switching and protective devices and the connections shall be designed to carry continuously a current of 1.3 times the current that would be obtained with a sinusoidal voltage of an rms value equal to the rated voltage at the rated frequency. As the capacitor may have a capacitance equal to 1.15 times the value corresponding to its rated output, this current may have a maximum value of 1.15 times the rated current.*

*Cable cross section considered as under for different rating capacitor banks are as follows:*

| *Sr No* | *Capacitor Rating* | *Rated current of capacitor (A)* | *Current at 1.3 Rated Current* | *Cable cross section selected* | *Current capacity of cable @70°C* | *Is Current capacity higher than 1.3 Rated current* |
|---|---|---|---|---|---|---|
| *1* | *5 KVAr 440V* | *6.6* | *8.58* | *1.5 Sq mm* | *14* | *Yes* |
| *2* | *10 KVAr 440V* | *13.1* | *17.03* | *4 Sq mm* | *26* | *Yes* |
| *3* | *15 KVAr 440V* | *19.7* | *25.61* | *6 Sq mm* | *33* | *Yes* |
| *4* | *20 KVAr 440V* | *26.2* | *34.06* | *10 Sq mm* | *45* | *Yes* |

**Considering the current at 1.3 times the rated current, the cable cross section has been selected.*

*It may also be apprised that inrush current of capacitors exists at the time of switching on & off of LV capacitors as these capacitors are intended for permanently connected to LV network, hence ideally there will not be switching & thus there will not be any inrush current. However, inrush current will exist at the time of input supply off & on situation. It may also be noted that even if inrush current exists, that will be for some micro seconds*

*only and thus not affecting it while deciding the Cable cross section. However, cable cross section is chosen as almost 2 times of rated current to have further redundancy.*

*INRUSH Current for switching of 1 Capacitor at a circuit*

*…*

*However, capacitor chosen in TS as a most robust one to sustain Inrush current to the tune of 300 $I_{N.}$*

***Point no. 4:*** *As the impact of improved power factor will be on whole network, the calculations were made based on the data of whole network and not only the LT network. Since, there is no mechanism at present to fetch the average power factor of whole LT network, it is not possible to calculate the savings of LT networks only. Hence, Hon'ble commission is kindly requested to consider the saving calculation as calculated earlier i.e. based on average power factor of one complete year (from 01.01.2024 to 31.12.2024) received from the FMS data of 686 feeders through RT-DAS System.*

*It is also submitted that load is continuously increasing across the state and during peak load seasons the low voltage and poor power factor issues are observed in several parts of the state, resulting in losses and posing a threat to grid stability. The State Government has also expressed concern over these issues, particularly in relation to the Char Dham Yatra and drinking water schemes. Considering these concerns, installing LT capacitor banks is a key step in correcting the power factor of the system, which can help in improving voltage profile, mitigate losses and ensure grid stability.*

*Hon'ble Commission is therefore humbly requested to kindly accord the approval for investment for aforesaid project."*

13. Further, the Petitioner vide its e-mail dated 08.07.2025 submitted the details of Circle-wise DTs exists in their network as mentioned below:-

| S. No. | Circle | DTR Capacity(KVA) | | | | | | | | | | Total DTRs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1000 | 800 | 630 | 500 | 400 | 250 | 160 | 100 | 63 | 25 | |
| 1 | Dehradun Rural Circle | 1 | 2 | 6 | 10 | 71 | 186 | 23 | 1,174 | 600 | 394 | 2,467 |
| 2 | Chakrata Circle | - | - | - | - | 4 | 47 | - | 127 | 130 | 545 | 853 |
| 3 | Dehradun Urban Circle | 6 | - | 29 | 25 | 193 | 657 | 41 | 1,057 | 349 | 96 | 2,453 |
| 4 | Haridwar Circle | 38 | 6 | 22 | 42 | 230 | 432 | 7 | 1,949 | 895 | 5,135 | 8,756 |
| 5 | Roorkee Circle | 3 | - | 9 | 27 | 144 | 390 | 21 | 1,528 | 1,601 | 10,113 | 13,836 |

| S. No. | Circle | DTR Capacity(KVA) | | | | | | | | | | Total DTRs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1000 | 800 | 630 | 500 | 400 | 250 | 160 | 100 | 63 | 25 | |
| 6 | Tehri Circle | - | - | 4 | - | 43 | 141 | 12 | 372 | 735 | 2,188 | 3,495 |
| 7 | Srinagar Circle | 2 | - | 4 | 1 | 50 | 153 | 22 | 669 | 1,023 | 2,822 | 4,746 |
| 8 | Karnprayag Circle | - | - | 1 | 7 | 25 | 64 | 1 | 237 | 584 | 2,676 | 3,595 |
| 9 | Ranikhet Circle | - | - | 3 | - | 32 | 90 | 12 | 339 | 687 | 3,893 | 5,056 |
| 10 | Haldwani Circle | 3 | - | 12 | 25 | 153 | 552 | 58 | 2,478 | 1,827 | 1,940 | 7,048 |
| 11 | Kashipur Circle | 6 | - | 14 | 6 | 121 | 261 | 21 | 1,346 | 1,512 | 5,292 | 8,579 |
| 12 | Rudrapur Circle | - | - | 2 | 32 | 184 | 265 | 5 | 1,461 | 1,385 | 4,142 | 7,476 |
| 13 | Pithoragarh Circle | 3 | - | 2 | 3 | 26 | 51 | - | 180 | 365 | 2,228 | 2,858 |
| 14 | Champawat Circle | - | - | - | 13 | 41 | 109 | 4 | 757 | 1,246 | 3,515 | 5,685 |
| Grand Total | | 62 | 8 | 108 | 191 | 1,317 | 3,398 | 227 | 13,674 | 12,939 | 44,979 | 76,903 |

"

14. A meeting in the matter was held on 23.07.2025 in the Commission's office, whereby, the issues pertaining to the proposed works were discussed. Thereafter, UPCL vide its letter no. 3581/D(O)/UPCL/UERC/C-4 dated 24.07.2025 made its following submission:-

"*In reference to the meeting held in the Hon'ble Commission's office on 23.07.2025, wherein it was pointed out that the submission of UPCL regarding establishment of need be based on system study at DT level rather than for whole network as submitted by UPCL. In this regard it is again submitted that at present there is no mechanism available to fetch the data at DT level hence, the study was carried out based on NFMS data of 686 no. 11 kV feeders of the State covering all seasonal and regional variations for one year. The report itself shows that the installation of Capacitor Banks at Distribution Transformers would be beneficial and lead to reduced line losses if done in accordance with the requirement of the system/network.*

*With regard to the above, it is humbly submitted that UPCL has carried out studies and as has been submitted by UPCL in its various submissions before the Commission. All other concerns raised in deficiency notes have been properly addressed. However, UPCL at the time of installation of Capacitor Banks at Distribution Transformers would ensure to comply with the directions of Hon'ble Commission.*

*Therefore, we humbly request and would be highly grateful to the Hon'ble Commission if the investment approval is allowed and we also assure that we shall ensure the safety and other technical aspects towards achieving the objectives of the Project.*

*We will be grateful if the proposal in the matter is approved by the Hon'ble Commission submitted."*

**Commission's Observations, Views & Directions: -**

15. Based on the examination and analysis of the Petition & subsequent submissions made by the Petitioner before the Commission, the observations, views & directions of the Commission are as follows:-

(1) The Petitioner in its instant proposal has proposed for the installation of LT capacitor banks on 76,903 nos. Distribution Transformers (25 kVA & above excluding 16 kVA and PTW DTs) out of the existing total 93,196 nos. Distribution Transformers (DTs) in UPCL for improvement of voltage profile and power factor. The Petitioner, with the installation of proposed LT capacitor banks has anticipated reduction in overloading, improvement in power factor, improvement in voltage profile, reduction in line losses & DT failure rate, reduction in capital expenditure and operational reliability due to less breakdowns in its networks.

The Petitioner in its DPR has estimated Rs. 147.11 Cr. as the cost of the project including Rs. 5.04 Crore cost against IDC and proposed 70% debt portion to be met through loan from the M/s REC Ltd. or any other financial institution and Equity portion i.e. 30% by Counter Funding/State funding. The cost of the project has been approved in 122nd Board of Directors meeting dated 17.03.2025. The average life of the LT capacitor banks submitted by the Petitioner is 1,30,000 Hrs.

(2) Regulation 3.1.2 'Reactive compensation and Harmonics' of UERC (Distribution Code) Regulations, 2018 mandates the determination of the size and location of the capacitor installations using appropriate computer software, with reliable field data. However, instead of assessing capacitor bank sizing based on the latest reliable field data, the Petitioner in its proposal has proposed the specific capacity of fixed type LT capacitor bank based on the kVA rating of Distribution Transformers. In its proposal for

installation of fixed type LT capacitor banks on DTs, the Petitioner has proposed the following specific size of capacitor bank: -

| Sr. No. | DTs Rating (in kVA) | Proposed LT capacitor bank rating (in kVAr) | Quantity (in Nos.) |
|---|---|---|---|
| 1 | 25 kVA | 5 kVAr | 45021 |
| 2 | 63 kVA | 10 kVAr | 12939 |
| 3 | 100 kVA | 15 kVAr | 13632 |
| 4 | 160 kVA | 30 kVAr | 227 |
| 5 | 250 kVA | 50 kVAr | 3398 |
| 6 | 400 kVA | 80 kVAr | 1317 |
| 7 | 500 kVA | 100 kVAr | 191 |
| 8 | 630 kVA | 120 kVAr | 108 |
| 9 | 800 kVA | 160 kVAr | 8 |
| 10 | 1000 kVA | 200 kVAr | 62 |
| **Total** | | | **76,903** |

On preliminary examination of the Petition, the Commission vide its letter dated 22.05.2025 had raised observation with regard to proper study and specific details pertaining to various capacitor banks to be installed at 76,903 DTs across the State. However, instead of furnishing the details of DT-wise proposed capacitor banks in the prescribed format, the Petitioner vide its submission dated 02.06.2025 failed to submit the aforesaid desired information and reiterated its earlier submission which was merely based on assumption of considering average power factor.

On non-receipt of the aforesaid information, the Commission vide its letter dated 06.06.2025 categorically directed the Petitioner to furnish the study report pertaining to requirement of the capacity of capacitor bank at each DT considering the factors namely kVA rating, maximum load, voltage profile, type of load (capacitive/inductive), location of transformer in the 11 kV network, space availability etc. based on which requirement could be justified. In response to this, the Petitioner vide its letter dated 16.06.2025 submitted generalized data which is based on the assumptions that average power factor of its network is 0.83 which is likely to be increased to 0.86 post completion of the ongoing 11 kV APFC panels installation (which would inject 387 MVAr into the network). The installation of proposed fixed type LT capacitor banks in the instant Petition would inject 886 MVAr into its network that would improve the average power factor of whole

network to 0.90. Further, the Petitioner submitted that there is no monitoring mechanism available at present at DT level to compile the whole data as desired by the Commission and the same would be available post implementation of the Smart Metering project which is under progress.

In this regard, for computation of the capacity of capacitor bank at each DT based on the reliable field data, the Commission vide its letter dated 20.06.2025 again sought the information in the prescribed format pertaining to the locations where Smart Meters have been installed at Distribution Transformers under RDSS scheme. In compliance to the same, the Petitioner vide its letter dated 30.06.2025 submitted the details of average power factor of 205 Nos. & 84 Nos. DTs of Garhwal & Kumaon region respectively and computed the total average PF of 0.85 & 0.83 for DTs of Garhwal & Kumaon region respectively based on the 02 months data fetched from the Smart Meter installed at DTs.

Since, the data furnished by the Petitioner is only for 02 months and thus does not account for the seasonal and regional variations of the State which is also highlighted by the Petitioner in its submission. However, on analysis of the aforesaid data furnished by the Petitioner, power factor of DTs has been observed as follows:-

| Region | Total DTs | PF<0.70 | 0.70<PF<0.85 | 0.85<PF<0.90 | 0.90<PF<1 |
|---|---|---|---|---|---|
| Garhwal | **205** | 25 | 28 | 29 | 123 |
| Kumaon | **84** | 11 | 21 | 27 | 25 |
| Total | **289** | 36 | 49 | 56 | 148 |

From the above table, it is evident that total 36 nos. DTs have PF less than 0.70, 49 nos. DTs have PF more than 0.70 but less than 0.85, 56 nos. DTs have PF more than 0.85 but less than 0.90 & 148 nos. of DTs have PF greater than 0.90. As is evident that 51% of the DTs for which data has been furnished by the Petitioner has already achieved the targeted power factor of 0.9 as proposed by the Petitioner in its instant Petition. Therefore, instead of proposing the specific capacity of capacitor bank at DT based on its kVA rating, the pre-requisite for such technical proposal is to conduct study at

each DT separately at field level based on the factors namely kVA rating, maximum load, voltage profile, type of load (capacitive/inductive), location of transformer in the 11 kV network, space availability etc. The two DTs of same kVA rating may require different capacity of capacitor bank when the computation for requirement of capacitor bank would be done based on the above factors.

Moreover, the requirement of reactive power compensation varies with the diurnal & seasonal variations in load. Therefore, the same calls for modulation in reactive power compensation as per the dynamic load requirements. The fixed type LT capacitor banks are unable to modulate its output as per the dynamic loading conditions which may lead to situations of overvoltage and leading power factors during low load and high solar generation conditions. Therefore, installation of fixed type LT capacitor banks should be done after comprehensive study.

In this regard, the Commission took cognizance of the above facts and therefore, is of strong view that for proper & effective implementation of the project, the Petitioner should conduct comprehensive study for estimation of adequately sized fixed type LT capacitor banks for each proposed location so that suitable fixed type LT capacitor banks are installed for catering the requirement of targeted power factor and future load growth requirements besides maintaining safety aspects.

(3) With regard to the requirement of size of cables considering inrush current for different rating of proposed capacitor banks, the Petitioner has submitted that inrush current of capacitors exist at the time of switching 'ON' and 'OFF' of LT capacitors and the same would exist for some microseconds only and thus not affecting it while deciding the cable size. It further submitted that the cable size is chosen as almost two times of rated current to have further redundancy.

In this regard, the Commission opines that consideration of adequate design aspects while planning & estimation of equipment is vital and thus calls for consideration of adequate margins w.r.t. harmonic/inrush current

tolerance, voltage variation, capacitor tolerance, cable derations due to temperatures and type of laying (air/ground/duct) while cable sizing. Hence, in the instant case, the Petitioner is required to methodically assess the requirement of assets/equipment prior to execution of the project and install appropriate size of cable and associated protection system for different ratings of fixed type LT capacitor bank duly considering aforesaid factors.

(4) With regard to the location for installation of fixed type LT capacitor bank at DTs, the Petitioner submitted that the same shall be installed directly on LT lines to minimize nuisance at ground level and in case the LT lines are not approachable, the fixed type LT capacitor banks shall also be installed on distribution boxes. For smaller rating of DTs (particularly 25 kVA), the fixed type LT capacitor banks shall also be installed on DT bushing through PG/bimetallic connector.

In this regard, the Commission suggests that while deciding the location of the fixed type LT capacitor bank at DTs or at LT network, the Petitioner alongwith other factors viz. space availability, safekeeping etc. should also consider the safety, accessibility & visibility factors.

Further, with regard to the accessibility & visibility of the LT capacitor banks, the Commission opines that the location of LT capacitor bank becomes very vital from operation & maintenance point of view when the same is of fixed type. Since, the proposed LT capacitor is of fixed type and shall always be in 'ON' mode, therefore, it should be visible by naked eyes in order to identify its working status and thus, accordingly be repaired/maintained as and when required. Further, the Commission opines that the maximum benefit of LT capacitor banks can be leveraged by installing them close to the load center locations which are predominantly of inductive nature so that $I^2R$ losses of the network can be minimized besides improving power factor & voltage.

Furthermore, with regard to the safety aspects associated with the installation of the proposed fixed type LT capacitor banks, the Commission

directs the Petitioner to educate its O&M staff regarding the pros & cons associated with the fixed type LT capacitor banks and ensure O&M works on the LT network only after complete discharge of the fixed type LT capacitor banks so that any untoward electrical accidents can be avoided. Therefore, it calls for complete isolation of the LT electrical network and complete discharging of fixed type LT capacitor banks prior to initiation of O&M works in the network.

(5) For ascertaining the performance of LT capacitor banks, the Commission sought the details of LT capacitor banks which were installed earlier by the Petitioner in its network. In reply, the Petitioner had submitted that 13474 Nos. LT capacitor banks were installed under APDRP scheme during FY 2004-05 and later total 3335 Nos. LT capacitor banks were installed under R-APDRP Part-B scheme during FY 2012-13 & FY 2013-14. However, with regard to performance of aforesaid LT capacitor banks that were installed earlier, the Petitioner in its submission dated 02.06.2025 submitted that at present no LT capacitor bank is available in its network and it has no record with regard to performance of these capacitors banks installed under the aforesaid schemes.

In this regard, the Commission is of the view that either the average life of the LT capacitor banks i.e. 130000 Hrs. (approx. 15 years) as stipulated by the Petitioner in its Petition is on higher side or the same have been obsoleted before completing its useful life *prima-facie* due to its improper engineering & design followed by maintenance of the same.

Although, in the instant proposal, the Petitioner has proposed the defect liability period of 05 years for the proposed fixed type LT capacitor banks, the Petitioner would be required to ensure the proper maintenance of the proposed fixed type LT capacitor banks post its defect liability period of 05 years so that it would be available to sustain till its average life i.e. 15 years as claimed by the Petitioner. Therefore, it becomes all the more important that the Petitioner should pay more attention on maintenance and careful operation of the proposed fixed type LT capacitor banks so that it could complete its useful life, because earlier retirement of the asset without

reaping the benefits of the investment on the same would result in substantial financial losses to the Petitioner.

(6) During the examination of Cost Benefit Analysis (CBA), payback sheets & calculations, it was observed that the Petitioner has considered the total annual consumption 13870 MUs, connected load of 8468 MW and T&D losses as 13.89% resulting in total annual saving of 137.31 MU in a simple payback computation of 777 days and payback period considering cash flow & other aspects as approx. 3 years & 02 months which is certainly depicting over-optimistic picture before the Commission. However, the payback calculations/saving should be computed considering the sales and connected load corresponding to the LT consumers intended to be served/connected to the proposed LT capacitor banks only and further, the pragmatic value of T&D losses be considered for arriving at prudent value of payback period. The Commission opines that the pragmatic payback period would be much higher than depicted by the Petitioner. Thus, the installation of LT capacitor banks should be for specific locations where it is really required.

The Commission believes that estimates should be pragmatic and not over-optimistic which gives false signals about an investment by depicting a rosy picture for substantiating an investment. The Commission is of the view that the Petitioner instead of considering over optimistic scenario should rely on pragmatic values for computation of financial analysis for its capital investment works.

(7) Further, the Commission opines that merely installation of proposed fixed type LT capacitor banks would not serve the purpose fully as the electricity supply through the distribution network is dynamic in nature and several other interventions would be required such as better monitoring & assessment, prompt maintenance, construction of new Substations, lines, etc. for improving the distribution system parameters. Thus, installing capacitor banks at DT locations is not one-stop solution for all the distribution sector problems such as low power factor, voltage profile, high technical losses, deferring investments for system augmentation etc. rather

it is one of the ways which can provide helping hand towards resolving the aforesaid issues.

(8) The Commission understands the benefits of the installation of LT capacitor banks at DTs/LT network with regard to reduction in load, improvement in voltage profile, reduction in line losses & DT failure rate etc. However, the Petitioner is strictly cautioned that inappropriate sizing and installation of fixed type LT capacitor banks may wipe out the aforesaid anticipated benefits and the same, if not implemented after due-diligence study may result in overvoltage, increased losses in the network, increased DT failure rate etc. Therefore, in absence of DT-wise reliable field data and performance of earlier installed LT capacitor banks, UPCL should conduct proper study of the need/requirements of LT capacitor bank at each DT/LT network and based on the said study, appropriate location could be identified.

In this regard, UPCL vide its letter no. 3581/D(O)/UPCL/UERC/C-4 dated 24.07.2025 assured to comply with the directions of the Commission. The Commission took cognizance of the aforesaid letter and is of the view that if deficiencies and concerns pointed out in the instant Order are redressed, it would make the proposed investment beneficial. Therefore, to achieve the objectives of proposed work, i.e. installation of fixed type LT Capacitor Banks at Distribution Transformers/LT network, the Petitioner shall ensure redressal of all the concerns, issues & directions mentioned in this Order.

16. Hence, the Commission grants in-principle approval for the proposed works subject to the fulfilment of terms and conditions mentioned below: -

(1) The Petitioner is required to consider the observations/directions of the Commission dealt in this Order while executing the works, besides binding the successful bidder to ensure compliance with the below mentioned conditions.

(2) The Petitioner is directed to go for the competitive bidding for obtaining the most economical prices from the bidders under the prevailing Rules & Regulations.

(3) The Petitioner is directed to conduct a comprehensive study before execution for estimation of specific ratings of capacitor banks at each proposed DT/LT network, based on the reliable field data namely kVA rating, maximum load, voltage profile, type of load (capacitive/inductive), location of transformer in the 11 kV network, space availability etc. so that LT capacitor banks of suitable rating could be installed for catering the requirement of targeted power factor and also future load requirements duly considering the safety & other technical aspects. However, where the Petitioner is installing HT Capacitors at upstream of the proposed LT Capacitor Banks, in such case the study shall be conducted after installation of the said HT Capacitor Banks. The Petitioner should ensure to keep the records of study & estimation mentioned above.

(4) The Petitioner is directed to methodically assess the requirement of assets/equipment prior to execution of the project and install appropriate size of cable and protection devices for different rating of capacitor banks duly considering factors viz harmonic/inrush current tolerance, voltage variation, capacitor tolerance, cable derations due to temperatures and type of laying (air/ground/duct).

(5) All the loan conditions as may be laid down by the funding agency in their detailed sanction letter are strictly complied with. However, the Petitioner should explore the possibility of swapping this loan with cheaper debt option available in the market.

(6) The Petitioner is required to submit the scheduled program in the form of Bar Chart within 15 days of the Order. Further, Petitioner is required to submit monthly report on the progress of installation of fixed type LT Capacitor Banks vis-a-vis the scheduled program of the Project by 15$^{th}$ day of the next month on regular basis.

(7) Defect Liability Period contract be framed in order to ensure the highest degree of Service Level Agreement (SLA) with appropriate Liquidated Damages (LD) clause for compensating the Petitioner against default in agreed SLA.

(8) The Petitioner is required to incorporate appropriate clauses in its contract of instant project/proposal for mitigating the effects of harmonic current & over voltage by complying to the relevant provisions of CEA Regulations and ensure implementation of solutions for mitigating the same.

(9) The Petitioner is required to educate its O&M staff regarding the pros & cons associated with the fixed type LT capacitor banks and execute O&M works on the LT network only after complete discharge of the fixed type LT capacitor banks so that any untoward electrical accidents do not occur. The complete isolation of the LT electrical network and complete discharging of fixed type LT capacitor banks should be ensured prior to initiation of O&M works.

(10) The Petitioner should comply to the following CEA and UERC Regulations and amendments thereof while execution and Operation & Maintenance of the proposed project and should ensure the compliance of relevant standards and the Project should be executed with safety and due diligence:

(a) Central Electricity Authority (Safety requirements for construction, operation and maintenance of electrical plants and electric lines) Regulations, 2011.

(b) Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022.

(c) Central Electricity Authority (Measures relating to Safety and Electricity Supply) Regulations, 2023.

(d) UERC (Distribution Code) Regulations, 2018.

(11) The Petitioner shall submit half yearly report with regard to working status, performance & maintenance of all the fixed type LT capacitor banks installed in its network before the Commission supported with relevant documents.

(12) The Commission may verify/check the proposed works to be executed by the Petitioner at any point of time during/post execution of the works from the perspective of not only substantiating that assertions & commitments

made by the Petitioner have been fully complied, but also to assess loading on transformer, power factor & voltage level alongwith rating & quality of equipment, optimum utilization of resources etc. as has been projected by the Petitioner.

(13) Post execution of the project, the Petitioner shall submit the Project Completion Report to the Commission alongwith details of fixed type LT Capacitor bank installed at each DTs/LT network, power factor & voltage profile before and after installation of LT capacitor bank, substantiated by relevant document, photographs of the installation with date, expenditure incurred/completed cost, financing of the Project and detailed analysis & calculations of the benefits accrued from the proposed works.

(14) The cost of the project and servicing on the same, as applicable, shall be allowed in the Annual Revenue Requirement of the Petitioner after the assets are capitalized and subject to prudence check of cost incurred. One of the basis for the approval of the investment is the Cost Benefit Analysis. The parameters stated in the Cost Benefit Analysis are required to be achieved to justify the investment and the same shall be criteria for prudence check of the proposed works in ARR Petition. Therefore, proper record keeping for the same shall be ensured by the Petitioner.

17. The approval is given subject to the above conditions and on the basis of submissions and statement of facts made by the Petitioner in the Petition and subsequent submissions. In case of violations of any of the condition mentioned above or in case any information provided, if at any time, later on, found to be incorrect, incomplete or in case relevant information was not disclosed, that materially affects the basis for granting the approvals, in such cases, the Commission may cancel the approval or refuse to allow all or part of the expenses incurred in the ARR/True-up apart from initiating plenary action.

Ordered accordingly.

**(Anurag Sharma)**
**Member (Law)**

**(M.L. Prasad)**
**Member (Chairman)**