

KERALA STATE ELECTRICITY REGULATORY COMMISSION
THIRUVANANTHAPURAM

Present: **Shri. Preman Dinaraj, Chairman**
Shri. S. Venugopal, Member
Shri. K. Vikraman Nair, Member

Petition No. OP 30/2019

In the matter of : Grant of power factor incentive for leading power factor to Kochi Metro Rail Ltd.

Petitioner : Kochi Metro Rail Ltd

Respondent : Kerala State Electricity Board Limited

Petitioner represented by : Sri. A R Rajendran, General Manager
Sri. Paul Jasy Anter, Deputy GM (P&T)
Sri. Thomas, C R

Respondent represented by : Sri. Bipin Sankar, Deputy CE, TRAC
Sri. K G P Nampoothiri, EE TRAC
Sri. Rajesh R AEE, TRAC
Sri. Sreekumar C, SS, SOR
Sri. Justin R, SA, SOR

Order dated 07.06.2019

1. Kochi Metro Rail Ltd (hereinafter referred to as the petitioner or KMRL) filed a petition before the Commission with the following prayers;
 - (i) *Leading power factor of KMRL to be treated as Unity Power factor since KSEBL specifications call for leading power factor to be treated as unity and Power factor incentives may be granted.*
 - (ii) *Power factor Incentive from the period starting from Demand Notice June 2017 may be awarded to KMRL.*
2. KMRL submitted as follows:
 - (i) KMRL is an EHT consumer of KSEB Ltd, at voltage level of 110 kV and availed power w.e.f 21.07.2016. The energy meter was commissioned on 21.07.2016 at Kalamassery 220kV substation. Kochi Metro receives power from 220kV Substation Kalamassery, of KSEB Ltd, at 110kV KMRL Muttom Receiving substation. The power distribution is done at 33 kV cable laid along the Metro route.
 - (ii) The energy meter installed by KMRL at 110 kV substation of KMRL at Muttom, measures the leading power factor also. The meter was

procured and installed as recommended by KSEB Ltd. Initially KSEB Ltd penalised KMRL for leading power factor, however subsequently the penal bills were withdrawn after several representation at offices of KSEB Ltd.

(iii) In the case of other HT&EHT consumers, the energy meter installed by KSEB Ltd measures the leading power factor as unity power factor, and such consumers with unity power factor is getting incentives. However, KSEB Ltd is not providing pf incentives to KMRL, though the pf is on the lead side.

(iv) On 28.03.2018, KMRL approached the CGRF at Ernakulam with following prayers.

(a) KMRL may be permitted to allow necessary software changes (leading pf to be treated as unity pf) in the energy meter procured by KMRL which is installed at Muttom Receiving Substation at par with the existing energy meter specifications published in the website of the licensee and which are in-line with existing EHT/HT consumers.

(b) Power factor Incentive during the period from June 2017 onwards may be awarded to KMRL

(v) The CGRF, vide the Order No. CGRF-CR/OP No 162/2017-18 dated 24.10.2018 ordered that;

A) The respondent shall take up the issue relating to the software changes of the energy meter installed in the premises of the consumer with the Hon'ble KSERC within one month from the date of receipt of this order.

B) There is no provision in the existing Tariff order for providing incentive for leading power factor. The petitioner shall take up the matter with the Hon'ble KSERC.

C) The respondent shall take necessary action after getting direction from Hon'ble KSERC.

D) No cost ordered.

(vi) Incompliance of the order of the CGRF, the petitioner filed this petition before the Commission.

3. KSEB Ltd. vide letter dated 01.03.2019 submitted their comments on the issue. The summary of the comments submitted by KSEB Ltd are as follows;

(1) A high power factor in the system signals an efficient utilization of electric power whereas a low power factor indicates a poor utilization of electric power. This stands applicable in the case of both leading and

lagging power factor also as both capacitive var and inductive var injected into the system in excess can be detrimental to the network or the following reasons;

- (i) The utilization of transformer capacity is blocked due to increase in current.
- (ii) Line loss gets increased due to increase in current.
- (iii) Over voltage problems occur in the network under leading power factor condition.

In an alternating system for the same load, the current is minimum at unity power factor. For any load other than unity power factor, whether leading or lagging, current is bound to be higher. As the power loss in a system is proportional to the square of the current in the system, the losses would always be higher at any power factor other than unity. Accordingly, the leading and lagging power factor should be controlled for having the desired target. Technically, the reactive compensation is effective when it is nearer to the load. Accordingly, any compensation (capacitive var or inductive var) made not nearer to the load will incur more loss to the system.

Further, the injection of capacity var and inductive var into the system will cause high voltage and low voltage conditions. Excessive over voltages may result in equipment flash over and failure endangering the system stability. In view of the above facts, it can be seen that injection of leading power factor in excess is not always beneficial for the system.

- (2) Regulation 2 of part IV of Grid Connectivity Standards of the Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 states that;

“2.Reactive Power

*The distribution licensees shall provide adequate reactive compensation to compensate the inductive reactive power requirement in their system so that they do not depend upon the grid for reactive power support. The power factor of the distribution system and **bulk consumer shall not be less than 0.95.**”*

The Petitioner being a consumer who had availed supply under 110kV supply does come under the definition of the bulk consumer. Accordingly, the petitioner is liable under the regulation to maintain power factor between 0.95 lag- 0.95 lead for system security. Further, in the amendment of the said regulation published on 08.02.2019, the clause 12 (3) states that; “(3) The user may be disconnected from the grid by the licensee for non-compliance of any provision of these regulations and any non-compliance of the provision of these regulations shall be reported by the licensee or the State Load Dispatch Centre, as the case may be, to the appropriate Commission.”

Accordingly, the petitioner being a 'user' as per the above amendment regulation is liable to maintain power factor above 0.95. However, it is observed that the petitioner's power factor has gone below 0.6 lead during many months in the past year, which is in violation to the standards prescribed.

- (3) Tamil Nadu Electricity Regulatory Commission has withdrawn the incentive component for power factor improvement.
- (4) Maharashtra Electricity Regulatory Commission (MERC) vide the order dated 12.09.2018 in Case No. 195 of 2017, has ordered to introduce penalty for leading power factor, since higher magnitude of leading power factor is also not desirable.

KSEB Ltd further submitted that, there is no merit in the arguments raised by the appellant and hence requested to reject the petition filed by M/s KMRL.

4. The Commission admitted the petition as OP No. 30/2019 and the hearing on the petition was conducted on 05.03.2019 at the Court hall of the Commission. Sri. A.R. Rajendran, General Manager, KMRL, presented the matter on behalf of the petitioner and Sri. Bipin Sankar P, Deputy Chief Engineer, presented the counter argument on behalf of the respondent KSEB Ltd.
5. During hearing, Sri. A.R Rajendran, General Manager, KMRL submitted the following.
 - (i) KMRL is an EHT consumer of KSEB Ltd, availing power with effect from 21.07.2016. Initially, the billing was based on the readings on the energy meter installed at the 220 KV substation of KSEB Ltd at Kalamassery. The energy meter installed at Kalamassery was a unidirectional meter complying with specifications of KSEB Ltd, recording the leading power factor as unity power factor and KMRL was getting power factor incentives.
 - (ii) Subsequently, on 23.05.2017, the metering point was shifted to 110kV substation of KMRL at Muttom, and the energy meter installed is bi-directional meter. The meter installed at Muttom records leading power factor and initially KSEB Ltd imposed penalty, and subsequently KSEB Ltd withdrew the penalty. However, no incentive was provided by KSEB Ltd. According to the petitioner, KSEB Ltd has to treat the leading power factor as unity, and has to provide incentive.
 - (iii) KMRL also submitted that, they have another connection at Kaloor at 33kV level for availing 1 MVA load, wherein the energy meter installed is unidirectional meter, recording the leading power factor as unity power factor and getting incentive.

- (iv) KMRL further submitted that, they are making investments for power factor correction for avoiding penalty if any likely to be imposed by KSEB Ltd for leading power factor.
6. Sri. Bipin Sankar, Deputy Chief Engineer on behalf of KSEB Ltd submitted the following before the Commission,
- (i) The Commission may, completely revisit the power factor incentive and penalty provisions prevailing in the State, duly considering the investment made by the consumers for improving the power factor and the benefits already accrued by the consumers.
 - (ii) There is no advantage to the KSEB Ltd due to the leading pf injected into the system by KMRL.
 - (iii) However, KSEB Ltd decided not to impose any penalty for the leading power factor injected by KMRL. Both the leading and lagging power factor is detrimental to the power system. Hence KSEB Ltd decided not to grant incentive for leading power factor.
 - (iv) While finalising the existing technical specifications of meters, KSEB Ltd did not anticipate the issues of leading power factor. However, KSEB Ltd may change the existing metering specifications so that, the meters to be installed shall record both the leading and lagging power factor.

The Commission clarified during the hearing that, the Commission vide the order dated 13.11.2017 in Review Petition No. 07/2017 filed by KSEB Ltd, had issued following directions to the KSEB Ltd for compliance.

“27. The Commission has noted the issues raised by KSEB Ltd and HT & EHT Association regarding the power factor and related issues. Almost all the issues raised by KSEB Ltd are the same raised during the public hearings of the suo-motu determination of tariff and the Commission has considered the same while issuing the tariff order dated 17.04.2017. The new issues raised by the KSEB Ltd including the revenue shortfall on account of the power factor incentive is out of the purview of the review jurisdiction of the Commission. Hence the plea of the KSEB Ltd in this matter is rejected. However, KSEB Ltd may, at its liberty can file a separate petition on power factor incentive/penalty and related issues before the Commission for consideration and approval. The Commission may decide on the matter, after inviting comments of the stake holders etc, as per the provisions of the Electricity Act, 2003 and KSERC (Conduct of Business) Regulations, 2003 and its amendments.”

However, KSEB Ltd is yet to comply with the above direction. It is up to the KSEB Ltd to file a proper petition with necessary supporting documents to completely revisit the pf incentive and penalty scheme in the State.

7. Based on the deliberations on the subject matter, the Commission vide daily order dated 08.03.2019 directed the KSEB Ltd to submit the clarifications/

additional details on the 'month wise energy meter reading details of KMRL Feeder at the 220 KV substation of KSEB Ltd at Kalamassery and at the 110kV substation of KMRL at Muttom from May 2017 onwards, latest by 20.03.2019.

8. KMRL, vide the letter dated 16.3.2019 submitted the monthwise energy consumption details and average PF, and its summary is given below.

Period	Metering	PF	remarks
August 2016 to June 2017	Metering at KSEB Ltd substation, Kalamassery (unidirectional meter)	1	PF incentive granted
July 2017 to October 2017	Metering at Muttom (summation type meter)	Leading (between 0.8 to 0.55)	No incentive
November 2017 to July 2018	Metering at Muttom (summation type meter)	Leading corrected to 0.9	No incentive
August 2018 to March 2019	Metering at KSEB Ltd substation, Kalamassery (unidirectional meter)	0.993 to 1.0	No incentive

9. KSEB Ltd, submitted the additional details on 03.04.2019. KSEB Ltd further submitted that, KMRL has been provided connection through a dedicated feeder from Kalamassery substation, and no other inductive load are there in the feeder. Considering the fact that, reactive compensation is effective when it is nearer to the load and also to the fact that the capacitor banks at the Kalamassery substation is underutilized, the capacity VAR injected by KMRL is not all benefiting the system.

Analysis and Decision

10. The Commission has examined in detail the petition filed by M/s Kochi Metro Rail Limited for granting incentive for leading power factor, the counter affidavit submitted by KSEB Ltd, with reference to the provisions in the Electricity Act, 2003, Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006 and its amendments, various Regulations notified by this Commission.
11. The basic issue to be addressed in this petition is that, whether the leading power factor can be treated as unity power factor and whether the consumers with the leading power factor may be granted power factor incentive, by treating the leading power factor as unity.
12. In order to get a clarity on the issue, the Commission has examined in detail the power factor in AC system, the causes of power factor, ways to improve the power factor. In this matter, the Commission has noted the following.

- (i) Power Factor (PF) is an indicator of efficient utilization of power. In an AC (Alternating Current) electrical power system, PF is defined as the ratio of real power flowing to the load, to the apparent power in the circuit and is a dimensionless number. In order to have an “efficient” system, PF is to be as close to 1.0(i.e. 100%) as possible.
- (ii) Current is generally lagged than voltage for phase at the large load, and hence the power factor is generally lagging power factor. Generally, inductive loads, which are sources of Reactive Power, are mainly responsible for low PF. These constitute a major portion of power consumed in industrial loads includes transformers, induction motors etc.
- (iii) Leading power factor means that the current leads the voltage, that is, the load is capacitive. If the load is inductive then the power factor is lagging and its sign is positive. When calculating kW from kVA use absolute value of the power factor because it will be the same whether the PF is leading or lagging.
- (iv) KSEB Ltd in their counter affidavit submitted as follows regarding the effect of leading power factor in the power system of the State.

‘ In an alternating system for the same load, the current is minimum at unity power factor. For any load other than unity power factor, whether leading or lagging, current is bound to be higher. As the power loss in a system is proportional to the square of the current in the system, the losses would always be higher at any power factor other than unity. Accordingly, the leading and lagging power factor should be controlled for having the desired target. Technically, the reactive compensation is effective when it is nearer to the load. Accordingly, any compensation (capacitive var or inductive var) made not nearer to the load will incur more loss to the system.

Further, the injection of capacity var and inductive var into the system will cause high voltage and low voltage conditions. Excessive over voltages may result in equipment flash over and failure endangering the system stability. In view of the above facts, it can be seen that injection of leading power factor in excess is not always beneficial for the system.

Utilisation of the transformer capacity may be blocked due to increase in current due to lead pf. Overvoltage problems may also occur in the network under leading power factor.’

13. The Commission has noted the arguments of the petitioner and respondent. It is a settled fact that, a low power factor, irrespective of whether it is ‘lagging or leading’ is detrimental to the power system. In order to incentivise the consumers for improving the power factor, this Commission has also introduced incentive and penalty since the year 2005. The existing rates of incentive and penalty are extracted below.

“Power factor incentive / disincentive

The following incentive and disincentive shall be applicable to LT industrial consumers with a connected load of and above 20 kW, HT&EHT Consumers for power factor improvement.

Power factor range	Incentive
Power factor between 0.9 to 1.00	0.50% of energy charges for each 0.01 unit increase in power factor from 0.9
Power factor range	Disincentive
Power factor below 0.90	1% energy charge for every 0.01 fall in power factor from 0.90

”

As above, the Commission has not limited the PF incentive/ penalty for lagging power factor alone. Further, the Commission also not intended to treat the leading power as unity and to provide incentive to the consumers.

14. The Commission has also examined the Regulation 2 of the Part IV of Grid Connectivity Standards of the Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007, which state as follows.

“2. Reactive Power

The distribution licensees shall provide adequate reactive compensation to compensate the inductive reactive power requirement in their system so that they do not depend upon the grid for reactive power support. The power factor of the distribution system and bulk consumer shall not be less than 0.95.”

As extracted above, the CEA Grid Connectivity Standards also mandate that, the power factor of the bulk consumer shall not be less than 0.95, however the CEA Regulation also not exempted the leading power factor from the reactive power compensation.

15. The Commission has also examined the power factor incentives and penalties provided in other States across the Country. It is noted that, in none of the States the leading power factor is treated as unity and allowed incentive for leading factor. However, in Tamilnadu, there is no incentives even for lagging power factor.

In the State of Maharashtra, MERC vide the order dated 12.09.2018 in Case No. 195/2017 stipulated that, the power factor penalties are applicable at the same rate for leading/ lagging power factor.

16. Considering all the documents and materials placed on record, this Commission is also of the view that, leading power factor also detrimental to the system similar to the lagging power factor. Hence there is no rational for treating the leading power factor as unity and to grant incentive for the unity power factor.

However, the Commission has decided not to impose penalty for leading power factor, since detailed study is required to ascertain the extent of losses and to quantify the damages causes by the leading power factor in the Kerala power system. Hence KSEB Ltd shall initiate a detailed study on the extent of

damages/ losses in the Kerala Power System on account of leading power factor.

17. It is also reported by the petitioner that, in the case of other HT&EHT consumers, KSEB Ltd has been treating leading power factor as unity and granting incentive for the unity power factor. As already clarified, the leading power factor cannot be treated as unity power factor and hence, no incentive shall be provided for the same. KSEB Ltd shall take immediate steps to correct this mistake and stop granting incentive for the same from the date of this order, prospectively.

Orders of the Commission

18. The Commission has examined in detail the petition filed by M/s Kochi Metro Rail Limited, the counter affidavit submitted by KSEB Ltd, with reference to the provisions in the Electricity Act, 2003, Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006 and its amendments, various Regulations notified by this Commission, orders as follows.

- (i) The leading power factor imposed by consumers shall not be treated as unity power factor and no incentive shall be granted for the leading power factor.
- (ii) Until further order, there will not be any penalty for leading power factor.
- (iii) KSEB Ltd shall study and report, the extent of damages/ losses in the Kerala Power System on account of leading power factor.

Petition disposed off. Ordered accordingly.

Sd/-
K. Vikraman Nair
Member

Sd/-
S. Venugopal
Member

Sd/-
Preman Dinaraj
Chairman

Approved for issue

G Jyothichudan
secretary