Before the
MAHARASHTRA ELECTRICITY REGULATORY COMMISSION
World Trade Centre, Centre No.1, 13th Floor, Cuffe Parade, Mumbai 400005.
Tel. 022 22163964/65/69 Fax 22163976
Email: mercindia@merc.gov.in
Website: www.mercindia.org.in/ www.merc.gov.in

CASE No. 329 of 2018

Case of Chamber of Marathwada Industries and Agricultural seeking clarification about the methodology to be followed for determination of Power Factor (lag or lead) of a consumer in MTR Tariff Order in Case No 195 of 2017

Coram
I.M. Bohari, Member
Mukesh Khullar, Member

Chamber of Marathwada Industries and Agriculture……. Petitioner

Vs

Maharashtra State Electricity Distribution Company Limited (MSEDCL) ……. Respondent

Brihanmumbai Electric Supply and Transport Undertaking …… Impleaded Respondent 1

Tata Power Company Limited …… Impleaded Respondent 2

Adani Electricity Mumbai Ltd …….. Impleaded Respondent 3

M/s. Mindspace Business Parks Private Limited …… Impleaded Respondent 4

M/s. Gigaplex Estate Private Limited …… Impleaded Respondent 5

Maharashtra Airport Development Company Limited …… Impleaded Respondent 6

Central Railway ……. Impleaded Respondent 7

Appearance

For Petitioner : Shri Hemant Kapdia (Rep)

For MSEDCL: Shri Satish Chavan (Rep.)

ORDER

Dated: 2 January, 2019

1. Chamber of Marathwada Industries and Agriculture **(CMIA)** has filed this Petition dated 12 November, 2018 under Section 62 and 63 of the Electricity Act 2003 read with Regulation 94 and 95 of the MERC (Conduct of Business) Regulation, 2004 for seeking clarification about the methodology to be followed for determination of Power factor (**PF**) (lag or lead) of a consumer in Mid Term Review **(MTR)** Tariff Order in Case No 195 of 2017.

2. CMIA's prayers are as follows:

a) The Hon'ble Commission may be pleased to expedite hearing of the Petition and in the meantime, may further be pleased to pass an interim Order directing MSEDCL to withdraw with immediate effect the instructions issued in respect of pf incentive / penalty;

b) The Hon'ble Commission may also be pleased to direct MSEDCL to revise the billing effected in the billing month of September 2018 based on suchinstructions of pf incentive / penalty and to refund the excess amount collected on account of pf penalty;

c) The Hon'ble Commission may further be pleased to call suggestions of all stake holders on this issue and after giving due consideration to the suggestions that may be received, may develop an appropriate and technically suitable formula / mechanism for implementation of pf penalty / incentive;

3. CMIA in its Petition has stated as follows:

3.1 MSEDCL in its MTRPetition had proposed to introduce kVAh billing system with the prime objective to encourage the consumers to maintain near unity PF to achieve loss reduction, improve system stability, power quality and voltage profile. As a corollary of such proposal MSEDCL has indicated that PF incentive will be nil once the kVAh based billing is implemented.

3.2 However, the Commission in its Order dated 12 September, 2018 has not permitted MSEDCL to introduce kVAh billing and observed that kVAh billing may not be appropriate at this juncture of time as it has to be done in a gradual manner to avoid any tariff shock. Accordingly the Commission has directed MSEDCL to submit its proposal for kVAh billing in next control period.

3.3 The Commission in its MTR Order dated 12 September 2018 has observed that: *"Though Power Factor Incentive mechanism encourages the consumer to improve its lagging Power Factor and maintain it to unity, there are cases of over compensation causing leading PF. There is no clarity about leading Power Factor in existing Tariff Order. As is the case with lagging PF, higher magnitude of leading Power Factor is also not desirable. Therefore, the Commission introduces penalty for leading PF also. This penalty will be applicable from prospective effect. As a first step towards the implementation of kVAh billing system, which is devoid of any separate incentive / penalty for PF, the Commission has decided to reduce the existing Power Factor Incentive / Penalty by 50%. Accordingly, maximum Power Factor Incentive, which is 7% at Unity Power Factor, has been reduced to 3.5%. Similarly, Penalty for lower Power Factor has been rationalized."*

3.4 The Commission in the said MTR Order has further directed MSEDCL to compute PF by applying following methodology:

PF Incentives /Penalty:While the average PF measurement is not possible through the installed meter, the following formula for calculating the average PF during the billing period shall be applied.

Average PF = Total (KWh)/ Total (KVAh)

Where KVAh is square root of the summation of the square of KWh and RKVAh)

3.5 MSEDCL has accordingly implemented the said Order dated 12 September 2018 with effect from 1 September 2018 and has billed the consumers for the billing month of September 2018 at revised tariff.

3.6 In the bill of September 2018, MSEDCL has devised absolutely a newformula and methodology for computation of PF incentives / penalties, which is altogether a different formula than what has been approved by the Commission. Such an action on the part of MSEDCL amounts to non-compliance and contempt (though may not be intentional) of Commission's order.

3.7 The formula adopted by MSEDCL for computation of PF, which violates the formula directed by the Commission is reproduced as under.

$$\text{Average PF} = \frac{\text{Kwh}}{\sqrt{\sum(kWh)^2 + \sum(RkVAhLag + Rkvahlead)^2}}$$

3.8 MSEDCL has further issued following guidelines for implementation of the said new formula of PF. The below mentioned guidelines have not been mentioned in the Circular, which is available on the web site of MSEDCL, but the same have been issued as an internal notification.

a) If PF level is less than 0.90 then penalty shall be as per percentage given in MERC order.
b) If PF level is greater than 0.95 and RKVAh lag consumption is greater than RKVAh lead consumption then PF incentives shall be given as per MERC order.
c) If PF level is greater than 0.95 and KVAh Lag consumption is less than RKVAh lead consumption then incentives shall not be applicable.
d) If the RKVAh lead reading is not available then old procedure of PF computation will be followed.

3.9 Better PF not only results in lower transmission and distribution losses, but also results in improvement in power supply quality. Historically prior to May 2000, only PF penalty mechanism was in existence and PF Incentivemechanism was introduced by the Commission in its first Tariff Order issued in year 2000, for incentivizing the consumers to take corrective measures for improving their PF. As already mentioned above, since higher magnitude of leading PF is also not desirable, in MTR Order the Commission has introduced penalty for leading PF also. The Commission has also clarified that such penalty will be applicable from prospective effect.

3.10 Without going in to the merits of the decision of introducing penalty for leading PF, CMIA at this stage, is seeking clarification about the methodology to be followed for determination of PF (lag or lead) of a consumer. CMIA submits that whenever the Commission introduces a new provision in tariff, it generally provides an illustration in the tariff order itself or subsequently provides clarification about the methodology for practical implementation of such revised provision in tariff. In the present Tariff Order dated 12 September, 2018 the Commission has not provided any appropriate clarification about how the new provision about lead PF would be implemented. Unless the Tariff Order dated 12 September 2018 (which runs in to more than 600 pages) is read very carefully, it is difficult to locate or identify the provision relating to leading PF.

3.11 MSEDCL by way of adopting a formula / mechanism which is not approved by the Commission, has imposed a heavy financial penalty on the consumers, who being unaware of such provision has maintained lagging PF. MSEDCL in its MTR Petition had not proposed any penalty for leading PF, so the general consumers were absolutely unaware about possibility of introduction of any such provision in the tariff order. Moreover the Tariff Order was issued on 12 September 2018 and has been implemented with retrospective effect, i.e. from 1 September 2018 and therefore the

consumer had no opportunity to carry out any correction in his PF recorded during the first 20 to 22 days of the billing month September 2018. Hence, by the time the general consumer could become aware of the provisions of the Tariff Order, more particularly about the revised mechanism / procedure of determination of PF incentive / penalty and accordingly takes necessary steps to reorganize his working / operations, the Commission may consider to defer the said provision for some time, say six / three months, as the Commission may think appropriate.

3.12 In the past, during the period of erstwhile MSEB, somewhere in the year 1985 or so, the erstwhile MSEB has enhanced the minimum PF level from 0.85% to 0.90%. . At that time MSEB had then given sufficient time to the consumers to make necessary changes in their operations, including installation of Reactive Power Management System and had deferred the implementation of the enhanced PF limit by 6 months or so. CMIA submits that the Commission may therefore please consider such precedence and may consider to defer the revised provision about lead PF for some time, say six / three months.

3.13 Energy meters installed for many consumers do not have the feature to indicate the RKVAh leading and lagging readings and in absence of such display on the meter, the consumers are facing difficulty / hardship to maintain and control the leading reactive units. Such a situation is unnecessarily causing discrimination amongst the same class of consumer since the consumers having energy meters with a facility to indicateRKVAh leading and lagging readings are getting undue preferential treatment. Section 62 of the Electricity Act, 2003 does not permit the Commission to show any undue preference to any consumer in determining the tariff.

3.14 All the consumers who are subjected to PF incentive / penalty need to be brought at par as far as metering is concerned and then only such provision could be implemented. The Commission while deferring the implementation of kVAh billing in the Tariff Order dated 12 September, 2018 has observed that it will require time for implementation.The same rationality or viewpoint also needs to be taken before the penal provision for leading PF is introduced / implemented.

3.15 In addition the MR - 9 form provided by MSEDCL to all HT consumers for maintaining day to day record of meter readings also do not include RKVAh lead and RKVAh lag reading parameters. This fact itself confirms that no prior intimation was given by MSEDCL before adopting the present methodology of computing PF.

4. MSEDCL in its submission has stated as follows:

4.1 CMIA in its Petition has not given any sufficient ground to review the MTR Order dated 12 September, 2018 passed by the Commission in Case No. 195 of 2017. Hence this Petition is not maintainable.

Regulatory provisions for PF**:**

4.2 As per the provision of Section 22 (General Conditions of Wiring) of Indian Electricity Rules 1956, it was mandatory for consumers to maintain the PF above 0.85.

4.3 As per the provisions of CEA (Technical Standards of Grid Connectivity) Regulation - Part IV dated 21-02-2007, it is mandatory for Distribution Licensees and Bulk Consumers to maintain PF above 0.95 so as to provide sufficient reactive compensation to their inductive loads. PF above 0.95 means it is for both lead and lag.

4.4 Unity PF is the most ideal and essential to maintain the healthiness of the Grid. There shall be no drawal or injection of the Reactive Power into the system. The bulk consumers mostly have the inductive loads connected into the system and most of the inductive loads have lagging PF and draws reactive power from the system.

4.5 The Commission vide its order dated 05 May, 2000 in the Case No.1 of 1999 introduced a mechanism to incentivize consumers if they maintain PF above 0.95 and more incentive was offered as consumers approach Unity PF. The Commission also introduced penalty if the PF is less than 0.9. The PF incentive for FY 2017-18 was 7% of the bill which was highest amongst any other utility in the country.

4.6 Over time, consumers have taken various measures to maintain the PF within the prescribed limit and in FY 2017-18, nearly 86% of the eligible consumers have availed the benefit of the PF incentive. The impact of this incentive in turn is getting passed on to the consumers by way of increase in their tariff.

4.7 It has been observed in the past that some of the consumers, in order to avail the maximum incentive of 7%, were keeping their capacitors in ON condition even when no load is connected to the system thereby maintaining leading PF i.e. on the pretext of availing incentive, consumers were over compensating. Such condition not only injects reactive power into the system but also is detrimental to the healthiness of the Grid for various reasons such as the utilization of transformer capacity (KVA) is blocked due to increase in current, line loss gets increased due to increase in current, over-voltage problem occurs in secondary side of transformer etc. This is not only harmful to grid but also to the consumer's equipment which is connected to system.

4.8 The requirement of maintaining Unity PF by the consumer shall be looked into with true spirit of Unity which is without any lead or lag component.

PF Calculation

4.9 The formula which is being used by MSEDCL is same formula which was used earlier. The formula which is approved by the Commission in MTR Order is the same formula which was approved by the Commission in earlier order dated 17 August, 2009 in Case No. 116 of 2008 as mentioned below

Wherever, the average Power Factor measurement is not possible through the installed meter, the following method for calculating the average PF during the billing period shall be adopted-

$$\text{Average PF} = \frac{\text{Total (kWh)}}{\text{Total (kVAh)}}$$

$$\text{Wherein the kVAh} = [\sqrt{\sum(KWh)^2} + \sum(RkVAh)^2]$$

(i.e., Square Root of the summation of the squares of kWh and RkVAh)

Same formula was being used for calculation of PF for all consumers. Now as per MTR order dated 12 September 2018 lead component of reactive energy i.e. RKVAh lead is also considered in the said formula and PF is calculated accordingly as below.

$$PF = \frac{KWH}{\sqrt{(KWH)^2 + (RKVAHLag + RKVAHLead)^2}}$$

4.10 As per IS 14697 – 1999 the kVAh is the vector sum of active and reactive energy. The relevant provision is reproduced below;

G-7 Guide for kVAh Measurement,

Vector sum volt-ampere is the vector sum of active energy and reactive energy in a 3-phase balanced load or unbalanced circuit.

Arithmetic sum volt-ampere is the arithmetical sum of the three products of line current and associated phase voltages in a three-phase balanced or unbalanced circuit.

However for static three parameter meters having high speed microprocessor adopting kVarh computation at very high rates, the vector sum value of kVarh tends to the arithmetic sum value in limiting case. Therefore, it is suggested to consider that wherever, kVAh has appeared in this specification, it is the same as the vector sum value. Thereby, it becomes easier to check the kVAh accuracy by determining errors of kWh and kVarh meters only in terms of kWh and kVarh measurement standards……

4.11 In above formula both the RKVAh Lag and Lead parameters are contrary; however their addition for billing is must as,

i. Both cannot occur simultaneously and for every time instance the resultant of both RKVAh lag and lead energies (being contrary parameters) is computed and get registered in either register (RKVAh lag or RKVAh lead) according to the predominance at respective instances.

ii. As they are recorded at different time spans/slots and both (lead & lag) are responsible to deviate the system from Unity PF (UPF) and hence, both are liable for penalty.

For example, during an hour,
KWh = 4, RKVAh *Lag* = 3, then KVAh = 5.
During next hour,
KWh = 4, RKVAh *Lead* = 3, then KVAh = 5.

This does not mean that both Reactive energies should cancel each other and resultant reactive energy should be consider for billing purpose is equal to Zero, because as they are recorded at different time instances both are equally responsible for loading the system (either lead or lag) with 5 KVAh apparent power.

Hence, the formula applied is correct and as per prevailing Indian Standards and MERC Orders.

4.12 It has carried out the actual load test of sample consumers using Electronic reference Standard Meter (ZERA) and compared the recorded PF by ZERA and the calculated PF of consumer as per the Commission's formula. The abstract of the test results is as below;

Sr. No	Name of O&M Circle	Consumer Name	Consumer No	Billing PF as per formula	PF as per ZERA ERSM reading (ZERA KWH/ ZERA KVAH)
1	Thane	M/s Executive Engineer, MIDC	000019007316	0.940	0.945
2		M/s National Education Society	022919025910	0.877	0.869
3		M/s Math bros. Engineers Pvt.Ltd.	000019005216	0.938	0.892
4	Vashi	M/s. Warna Sahakari Dudh Utpadak Prakriya sangh	000289043870	0.934	0.882
5		M/s. Pritrade Issues (I) Pvt. Ltd.	000149039240	0.926	0.894
6		M/s. DOL Electric Company Pvt. Ltd.	000119039410	0.997	0.982

4.13 From the test results, it can be verified that the actual PF as per Electronic reference Standard Meter (ZERA) is in fact on slightly lower side than the PF computed using approved formula, benefitting the Consumer.

Retrospective application of PF Incentive/Penalty and LF Incentive**:**

4.14 As the Commission in its MTR Order in Case No.195 of 2017 under Applicability clause has ruled that the Order shall come into effect from 1 September, 2018 MSEDCL is bounded to strictly adhere to above directive; MSEDCL has raised bills as per new tariff for billing Month of September, 2018.

Discrimination against few consumers**:**

4.15 All present meters installed at HT consumers have RkVAh Lead Power reading and according to the MTR Order, the Penalty for Lead/Lag PF as per the provision has been implemented.

Deferring implementation of revision in PF **:**

4.16 The present metering system installed at HT Consumer's end displays RkVAh Lead as well as Lag Power and as such consumer is already aware of Injection of Lead Reactive Power by him into the system and Drawal of Lagging Reactive Power from the system. Further, consumer is also aware of the detrimental impact of the Reactive Power on the Grid as he has been availing the incentive by keeping his PF closer to unity for all these years. As the implementation does not require any replacement of meters, there is no reason to defer the implementation.

4.17 The consumers were well aware of the MSEDCL's proposal of introducing kVAh based billing in its MTR petition. The consumers were also aware that the kVAh based billing has inbuilt PF Incentive/Penalty mechanism. The Consumers were also aware that MSEDCL has proposed to introduce the kVAh based billing in its MTR Petition as it has observed that some of the consumers are availing the highest PF Incentives by keeping the Leading PF.

4.18 There is no justification to provide any grace period for implementation of the revised PF Incentive / Penalty mechanism.

4.19 The contention of CMIA that in past erstwhile MSEB has enhanced the minimum PF level from 0.85 to 0.90 and has given sufficient time for consumers to make necessary changes in their operations and therefore this time also the implementation should have been deferred does not hold good in this case as the past change was introduced by

MSEB on its own whereas this time, the revision has been ordered by the Commission effective from the date specified in the MTR Order.

4.20 The present MR9 format provided by MSEDCL to all HT consumers is for maintaining day to day record of kWh, kVAh, kVA, MD etc as applicable for kWh method of billing. The inclusion of RkVAh Lead and Lag applicable in kVAh billing method will be done when the kVAh based billing will be introduced by the Commission.

5. BEST in its submission has stated as follows:

5.1 In the BEST there are 11702 consumers meters eligible for PF incentive/ Penalty. Out of which Approximately 6512 meters are not compatible for RKVAH leading and needs to be programmed which will require 3 Months time.

6. TPC-D in its submission has stated as follows:

6.1 The following parameters are available in the Energy Meter related to the PF computation:

- kWh Total
- RkVAh Lag
- RkVAh lead
- kVAh for Lag PF

6.2 The Energy Meter reads kVAh for Lag PF correctly. However, as per Meter specifications, the meter considers Leading PF as unity for calculating of kVA and kVAh. Hence, RkVAh total is not available from the meter. Since, RkVAh total is not available in the Energy Meter, it is proposed to derive the same using "RkVAh lag" and "RkVAh lead".

6.3 Accordingly, Tata Power-D proposes the following formula for deriving "RkVah Total" as follows:

RkVAh total = RkVAh Lag + RkVAh Lead

6.4 In addition to the above, to determine the average PF lead or lag, it is suggested to consider following Formula

If "RkVAh lead" > "RkVAh lag" then "Average P.F." is to be treated as "Lead P.F."
If "RkVAh lead"= < "RkVAh lag" then "Average P.F." is to be treated as "Lag P.F."

7. At the time of hearing held on 20 December, 2018while reiterating their submissions in the Petition CMIA has requested few months deferment for implementing revision in computing PF so that the consumers can make necessary arrangements / changes to maintain PF as per new methodology. MSEDCLhas reiterated the submission mentioned in the Petition.

8. MSEDCL in its additional submission in the matters related to PF computation has stated as follows:

8.1 In its MTR Petition, MSEDCL had proposed to introduce KVAh based billing which has inbuilt mechanism of PF Incentive/Penalty and no separate incentive/penalty mechanism was required. On that MTR Petition, the Commission and Consumer Representatives have raised their Data Gaps. In reply to the Data gaps raised, the issue of over compensation by installing more capacitors than required to avail the maximum benefit of PF incentive was specifically brought to the notice. Replies to the Data Gaps were also part of its MTR Petition and the same were available in the Public Domain and hence, the consumers were also aware of the same. Thus, it is incorrect to say that approved methodology for computation of PF Incentive/ Penalty was not a part of MSEDCL Petition.

8.2 MSEDCL has taken several measures to disseminate the information regarding change in incentive structure through its field offices. Some of the measures are listed below:

a. All HT consumers have been informed about FAQs (Frequently Asked Questions) regarding PF penalty/incentive and LF incentive as per MTR Order by way of e-mail on 5 October, 2018 on their registered e-mail IDs.

b. Document for new methodology for PF calculation is uploaded on Mahavitaran consumer portal.

c. Document for revised methodology of PF Penalty/Incentive as per MERC Order is sent through reply to Industrial consumers / associations.

d. Document for FAQ uploaded on employee portal and instructions given on 2 October 2018 to all field officers for circulation of the same to consumers visiting MSEDCL offices.

8.3 Comparative statement showing PF Incentive and Penalty levied to the consumers prior of MTR Order (August, 2018) and post MTR Order (September, 2018) is tabulated below:

Months	Consumers eligible for PF Incentive / Penalty	No. of Consumers who availed incentives	PF Incentives Amount (Rs. Crore)	Sale (MU)	% of consumer availed PF Incentive
A	B	C	D	E	F=C/B
August, 2018	126071	76119	(168)	3314	60%
September, 2018	127942	62165	(64)	2225	49%

Months	Consumers eligible for PF Incentive / Penalty	No. of Consumers on which Penalty imposed	PF Penalty Amount (Rs. Crore)	Sale (MU)	% of consumer with PF Penalty
A	B	C	D	E	F=C/B
August, 2018	126071	22947	13	124	18%
September, 2018	127942	33404	31	307	26%

Percentage of consumer availing PF Incentives has reduced by only 11% and percentage of consumer with PF Penalty has increased only by 8%. Thus, the alleged claim that large number of consumers have affected due to PF Penalty is not correct.

The Commission in MTR Order has made 50% reduction in PF Incentive / Penalty. PF Incentive for August, 2018 was Rs. 168 crore, with reduced rate of incentive it was expected to be Rs. 84 crore in September, 2018. Actual, PF incentives in the month of September, 2018 is Rs. 64 crore. Thus, impact of changed computation methodology on PF Incentive for the month of September, 2018 is Rs. 20 crore. Similarly, PF Penalty amount was expected to be reduced from Rs. 13 crore in August, 2018 to Rs. 7 Crore in September, 2018. However, actual PF Penalty in the month of September, 2018 is Rs. 31 crore. Thus, impact of changed computation methodology on PF Penalty for the month of September, 2018 is Rs. 25 crore. Thus, total impact of changed computation methodology on PF Incentive / Penalty in September, 2018 is only around Rs. 45 crore. Further, as consumers takes appropriate measures to maintain the PF within the limits as specified in MTR Order, this impact may reduced in the future.

8.4 As on date, present meters installed at all HT consumers have the capability to record RKVAh Lead and about 98% of LT Consumers having AMR/MRI facility has the provision of recording RKVAh Lead. According to the provisions of the MTR Order, the Penalty for Lead/Lag PF has been implemented for these consumers. Necessary corrective action for the remaining 2% of the LT consumers is in process.

Commission's Analysis and ruling:

9. The Commission notes that this Petition has been filed under Regulations 94 and 95 of the MERC (Conduct of Business) Regulations, 2004 seeking amendment / clarification

of the MTR Order dated 12 September, 2018 relating to PF. Although, Regulation 95 of the Conduct of Business Regulations empowers the Commission to amend its Order, while exercising such jurisdiction, the Commission needs to be conscious of Regulation 85 of MERC (Conduct of Business) Regulations, 2004 which restricts the powers of the Commission to review its decision only if there is error apparent on face of record or discovery of new fact.

10. In the present matter CMIA has not pointed out any error in the impugned MTR Order, but is seeking clarification relating to implementation of dispensation of the Commission relating to PF on the following issues:

    a. Date of Applicability
    b. Formula for computing PF
    c. Incentive for Lead PF

    Considering various Petitions filed before the Commission raising similar issues, the Commission has decided to address these issues so that consumers will have clarity on the subject matter.

11. In the impugned MTR Order dated 12 September, 2018 in Case No. 195 of 2017, the Commission has ruled on the PF Incentive / Penalty as follows:

    2.9.13. As regards Power Factor Incentive/Penalty mechanism, the Commission observes that since the first Tariff Order issued in year 2000, PF incentive / penalty is included in retail tariff for incentivising the consumers to take corrective measures of improving their Power Factor. As per current Tariff Order, 7% rebate in monthly electricity bill amount is provided for achieving unity Power Factor.

    2.9.14. Over the period, consumers in Maharashtra have taken appropriate measures to maintain their Power Factor near Unity. This helps the consumers and the Distribution Licensee as the consumers get rebate in their monthly electricity bill while the Licensee observes improvement in system Power Factor.

    2.9.15. Though PF Incentive mechanism encourages the consumer to improve its lagging PF and maintain it to unity, there are cases of over compensation causing leading Power Factor. There is no clarity about leading Power Factor in existing Tariff Order. As is the case with lagging PF, higher magnitude of leading Power Factor is also not desirable. Therefore, the Commission introduces penalty for leading PF also. This penalty will be applicable from prospective effect. As a first step towards the implementation of kVAh billing system, which is devoid of any separate incentive / penalty for Power Factor, the Commission has decided to reduce the existing Power Factor Incentive / Penalty by 50%. Accordingly, maximum Power

Factor Incentive, which is 7% at Unity Power Factor, has been reduced to 3.5%. Similarly, Penalty for lower Power Factor has been rationalized.

Similar ruling on the issues of PF Incentive / Penalty has been repeated in the MTR Orders of other Distribution Licensees in the State. Hence, all other Distribution Licensees have been impleaded in this matter as Respondents.

a. Date of Applicability:

12. Impugned MTR Order dated 12 September, 2018 has been made effective from 1 September, 2018 and hence change in PF Incentive / Penalties approved in MTR Order also becomes applicable from 1 September, 2018. MSEDCL has stated that in compliance of MTR Order, it made such changes applicable from 1 September, 2018 and accordingly billed its consumers. Whereas, Petitioner has contended that the Commission should have provide sufficient preparatory time to consumers for adjusting with the changes in the PF Incentive / Penalty.

13. In this regard, the Commission notes that PF Incentive / Penalty is an integral part of the Tariff. It is settled position of Law that retrospective applicability can be given to the Tariff Order. Hence, there is no error in making Tariff Order dated 12 September, 2018 effective from 1 September, 2018 and hence implementation of revised PF Incentive / Penalty from 1 September, 2018 cannot be claimed as error.

14. Further, the Commission notes that the Appellate Tribunal for Electricity (APTEL) in its Judgment dated 4 November, 2011 has upheld TNERC's Order of including 'RkVAh lead' in computation of PF. Relevant part of APTEL's judgment is reproduced below:

"

40.

.....

b. ……..It is an engineering fact that injection of VAR – inductive or capacitive – results in increased system losses. Further, electrical power system being predominantly inductive in nature, injection of inductive VAR results in low voltages and injection of capacitive VAR causes over voltages. Excessive over Voltages may result in equipment flashover and failure endangering the system stability. In order to keep system losses to minimum and system voltage with in permissible limits, it is always advisable to keep PF close to unity….."

Thus there is no error in inclusion of 'RkVAh Lead' in computation of PF.

15. Notwithstanding the above factual position, the Commission appreciates the concern raised by this Petitioner and others relating to allowing certain period before making

revised PF Incentive / Penalty effective. As noted in the impugned MTR Order, over the past period consumers in Maharashtra have made arrangements to keep its PF near to the Unity by considering only lagging RkVAh. Now, as per impugned MTR Order, leading RkVAh is also required to be included in computation of PF. Consumers needs to make necessary changes at their end at the earliest. BEST Undertaking has also stated that they will require three months time period for making necessary changes in Meter software.

16. Further, as per details submitted by MSEDCL (as summarized in para 8.3 above) changed methodology for computation of PF (inclusion of lead RkVAh) has reduced consumers availing PF incentives by 11% and increased consumers with PF penalty by 8%. The Commission notes that though maintaining the PF as per rules is a responsibility cast on the consumers, the same was not covered in the Tariff Order for lead PF. Details submitted by MSEDCL are for first month of MTR Order and consumers may not be fully aware of the changed methodology of PF computation. With, efforts being taken by Distribution Licensees in last few months to create awareness amongst the consumers, the Commission expects that consumers would have taken appropriate measures in last four months. As stated in the MTR Order, lead RKVAh needs to be considered in computation of PF. None of the Petitioners have opposed such change but have only sought some time for taking appropriate measures. This is a very positive attitude from consumers and considering that they have shown willingness to take appropriate measures, the Commission is inclined to grant some relief which will help such consumers in their efforts to install required equipment or make necessary changes in their processes so as to maintain PF within the prescribed limits.

17. As there is no error in inclusion of 'RkVAh lead' in computation of PF, the Commission is not changing effective date i.e. 1 September, 2018 for inclusion of RkVAh lead in computation of PF. However, in order to support the consumer who are willing to take corrective measures, the Commission rules that differential amount (difference between PF computed without 'RkVAh Lead' and with 'RkVAh lead') for the period of 1 September, 2018 to 31 March, 2019 will be refunded to the consumer as follows:

    a. Consumer shall be eligible for refund only if PF (with RkVAh lead) for consumption of April, 2019 is equal to or above 0.90 (lead or lag). No refund will be given to other consumers.

    b. This refund shall be in equal monthly installments. Number of installments shall be equal to numbers of months in which 'RkVAh lead' based PF has been billed to consumer till March, 2019.

c. First installment to the 'Eligible Consumer' shall be refunded by way of adjustment in the electricity bill for consumption of April, 2019.

d. Subsequent installment is refundable only if 'Eligible Consumer' maintains PF equal to or above 0.90 (lead or lag) in the month in which installment is to be refunded. If PF is below 0.90 (lead or lag), installment for that month shall deemed to be lapsed.

The final aim of this Commission is to maintain the healthiness and reliability of the electrical system. Accordingly, the Commission feels that in view of positive attitude of the consumers, and with above dispensation, consumers will be motivated to take corrective measures and invest in technological solutions, if required, so that PF computation with inclusion of 'RkVAh Lead' is within permissible limits or to earn incentives for maintaining PF near to Unity.

18. MTR Order stands modified to that effect. All Distribution Licensees in the State are directed to take corrective action accordingly.

19. For ample clarity, the Commission clarifies that above ruling is applicable only for the inclusion of 'RkVAh lead' in computation of average PF. There is no change in percentage of rebate / penalty stipulated in the MTR Order dated 12 September, 2018.

c. Formula for computing PF

20. The Commission notes that formula for computation of PF in the impugned Order is as follows:

Power Factor Computation
Where the average Power Factor measurement is not possible through the installed meter, the following formula for calculating the average PF during the billing period shall be applied:

$$\text{Average Power Factor} = \frac{\text{Total (kWh)}}{\text{Total (kVAh)}}$$

$$\text{Wherein the kVAh is} = \sqrt{\sum(KWh)^2 + \sum(RkVAh)^2}$$

(i.e., Square Root of the summation of the squares of kWh and RkVAh)

The above formula has been in use for computation of average PF since last several years. In the impugned MTR Order, though the Commission has ruled to include

'RkVAh lead' for computation of average PF, changes in formula for the same was not stipulated in the impugned MTR Order. Hence, consumers are raising doubts about the formula being used by the Distribution Licensees and suggesting deferent formulas for computing average PF.

21. In this regard, the Commission notes that in the impugned MTR Order dated 12 September, 2018, the Commission has ruled to impose penalty on lead PF. This ruling of the Commission requires 'RkVAh lead' to be included in computation of 'total kVAh'. Formula in the impugned MTR Order only states 'RkVAh', it does not specify lead or lag RkVAh. Till the issuance of impugned MTR Order, 'RkVAh' in the formula is considered as 'RkVAh lag' as 'RkVAh lead' was not part of computation of average PF.

22. In lag only billing system, only 'RkVAh lag' is considered for computation of average PF. With lag + lead billing system, 'RkVAh lag' as well as 'RkVAh lead' needs to be considered in computation of average PF. The Commission notes that readings of 'RkVAh lag' and 'RkVAh lead' are recorded in separate register in the Meter. Further, in case of general consumer who normally takes electricity from the Grid and do not inject electricity into the Grid, reactive energy in both these cases i.e. 'RkVAh lag' and 'RkVAh lead' flows from Grid to the consumer. The consumer takes 'inductive reactive energy' i.e. 'RkVAh lag' and 'capacitive reactive energy' i.e. 'RkVAh lead' at different point of time as per its load requirement. In both these case, reactive energy is provided by the Grid. Hence, these 'RkVAh lag' and 'RkVAh lead' need to be added to arrive at total RkVAh received from the Grid. Lead and lag need not be understood as opposite flow of energy, lead or lag represents angular difference between voltage and current vector.

23. In view of above, formula for 'total kVAh' in computation of average PF in the impugned MTR Order for computing PF with lead and lag RkVAh shall be read as follows:

$$\text{kVAh is} = \sqrt{\sum(\text{KWh})^2 + \sum(\text{RkVAh Lag} + \text{RkVAh Lead})^2}$$

24. Further, average PF so computed can be considered as leading or lagging based on the following test:

If "RkVAh lead" > "RkVAh lag" then "Average P.F." is to be treated as "Lead P.F."
If "RkVAh lead" = < "RkVAh lag" then "Average P.F." is to be treated as "Lag P.F."

25. The Commission notes that MSEDCL has adopted same methodology as stipulated above for computation of average PF. TPC-D has also proposed the same methodology.

26. The Commission also notes that Vidarbha Industries Association (VIA) in its Petition in Case No. 344 of 2018, has suggested a formula for computing the KVAh as below:

KVAh (Actual) = [√(KWh lag)^2 + (KVARh lag)^2] + [V(KWh lead)^2 + (KVAh lead)^2]

In the above formula, VIA has suggested to include 'KWh Lag' and 'KWh lead' in computation of PF. In this regard, the Commission notes that KWh is actual power and a scalar quantity, and has no leading or lagging component. Hence, the formula suggested by VIA is not correct.

d. Incentive for Lead PF

27. In the impugned MTR Order dated 12 September, 2018, the Commission has stipulated applicability of PF Incentive / Penalty as follows:

> ***"Power Factor Incentive***
> **……**
>
> *2. Whenever the average PF is more than0.95 lag and upto 1, an incentive shall be given at the rate of the following percentages of the amount of the monthly electricity bill, excluding Taxes and Duties:*
>
> *……..*
>
> ***Power Factor Penalty***
> **……**
>
> *2. Whenever the average PF is less than 0.9 (lag or lead), penal charges shall be levied at the rate of the following percentages of the amount of the monthly electricity bill, excluding Taxes and Duties:*
>
> *……."*

Thus, as per impugned MTR Order, although there is penalty for lag or lead PF below 0.9, there is no incentive for lead PF more than 0.95 which is available for lag PF.

28. Although MSEDCL has supported such dispensation stating that leading PF is harmful to the distribution system, Petitions relating of PF requested the Commission to provide incentive to lead PF similar to lag PF

29. In this regard, the Commission notes that any requirement of reactive energy (lag or lead) by the consumer burdens the electrical network with additional current feeding such requirement. Hence, the Commission has provided penalty for low PF (lag or lead). Similarly, for incentivizing consumers to improve PF and thereby reducing

reactive energy requirement from the Grid, the Commission provided incentive for PF above 0.95. The Commission notes that amount of reactive energy required for given lag PF is the same as that required for same lead PF. Hence, in the opinion of the Commission, there is case to provide incentive for lead PF also on the line similar to lag PF. This will ensure equitable treatment in case of Lag or Lead PF.

30. Accordingly, the Commission modify the applicability of PF Incentive in the impugned MTR Orders as follows:

> **"*Power Factor* Incentive**
> **……**
> 2. *Whenever the average Power Factor is more than 0.95* ***(lag or lead)*** *and upto 1, an incentive shall be given at the rate of the following percentages of the amount of the monthly electricity bill, excluding Taxes and Duties*:
> *……."*

31. MTR Order stands modified to this effect. Refund on account of this, if any, shall be given in three equal monthly installments through adjustment in energy bill. Refund under this clause is different form refund stipulated in para 17 above. All Distribution Licensees in the State are directed to take corrective action accordingly.

32. The Commission has also received request for restricting PF Penalty to 5%. In this regard, the Commission likes to clarify that historically there was never a limit on the PF Penalty. With every percentage reduction in PF, penalty was increasing by 1%. In the impugned MTR Order, such incremental penalty percentage has been reduced to 0.5% for each percentage reduction in PF. Hence, in the impugned MTR Order, the Commission has already reduced percentage of penalty. Further, with increased awareness amongst consumers and with refund of differential amount approved in this Order, it is expected that consumers take corrective actions to maintain its PF within limits and avoid penalty. Therefore, there is no need to impose ceiling on percentage of penalty for low PF.

33. As far as issue of MR9 form not being consistent with lead PF methodology, the Commission notes that such form is a format for manual collection of meter readings. With availability of advanced meter reading infrastructure, in order to avoid manual intervention, consumer's bills are being generated based on AMR / MRI data and hence MR9 has relatively low importance for billing purpose. Hence, in the opinion of the Commission, old MR9 forms do not affect the billing based on leading RkVAh.

34. Further, the Commission observed that as per MSEDCL's submission all HT consumers' meters are capable for recording RkVAh lag and lead separately and hence there is no issue in implementation of MTR Order. In regard to LT consumers,

MSEDCL has stated that only in case of few LT consumers they are facing difficulties on which corrective action is being taken. Hence, in the opinion of the Commission, there is no difficulties (except for few LT consumers) in implementation of lead RkVAh based PF computation. It would not be appropriate to hold back the implementation of technically correct methodology for computing PF just because few consumers. The Commission directs MSEDCL to take corrective actions in this regard on top priority within two months.

35. The Commission does not find any error apparent or discovery of any new fact. In spite of this, considering practical difficulties issues directions/clarifications.

36. Hence the following Order:

ORDER

1) **Case No. 329 of 2018 is partly allowed.**

2) **PF related matter in MTR Order dated 12 September, 2018 in respect of Distribution Licensees in the State are modified to the following extent:**

   a. **The effective date i.e. 1 September, 2018 for inclusion of 'RkVAh lead' in the computation of average PF remains same. However, in order to support efforts of consumers to take corrective actions, differential amount (difference between PF computed without 'RkVAh Lead' and with 'RkVAh lead') for the period of 1 September, 2018 to 31 March, 2019 will be refunded to the consumers in the following manner:**

      i. **Consumers shall be eligible for refund only if PF (with RkVAh lead) for consumption of April, 2019 is equal to or above 0.90 (lead or lag). No refund will be given to other consumers.**

      ii. **This refund shall be in equal monthly installments. Number of installments shall be equal to numbers of months in which 'RkVAh lead' based PF has been billed to consumer.**

      iii. **First installment to the 'Eligible Consumer' shall be refunded by way of adjustment in the electricity bill for consumption of April, 2019.**

      iv. **Subsequent installment is refundable only if 'Eligible Consumer' maintains PF equal to or above 0.90 (lead or lag) in the month in which installment is to be refunded. If PF is below 0.90 (lead or lag), installment for that month shall deems to be laps.**

b. **'total kVAh' for computing PF with lead and lag RkVAh shall be computed as follows:**

total kVAh is = $\sqrt{\sum(\mathbf{KWh})^2 + \sum(\mathbf{RkVAh\ Lag} + \mathbf{RkVAh\ Lead})^2}$

c. **Average PF can be considered as leading or lagging based on the following test:**

If "RkVAh lead" > "RkVAh lag" then "Average P.F." is "Lead P.F."

If "RkVAh lead" = < "RkVAh lag" then "Average P.F." is "Lag P.F."

d. **PF Incentive shall be applicable for PF more than 0.95 (lead or lag). Refund on account of this, if any, shall be given in three equal monthly installments through adjustment in energy bill. Refund under this clause is different from refund under clause 'a' above.**

e. **There is no change in percentage of PF rebate / PF penalty stipulated in the MTR Order dated 12 September, 2018.**

f. **All Distribution Licensees in the State are directed to take corrective action accordingly.**

Sd/-	**Sd/-**
Mukesh Khullar	**I.M.Bohari**
Member	**Member**

(Abhijit Deshpande)
Secretary