

BANGLADESH RURAL ELECTRIFICATION BOARD

**PBS INSTRUCTION 100-26
PBS INSTRUCTION 300-05**

POWER FACTOR MEASUREMENTS

BANGLADESH RURAL ELECTRIFICATION BOARD
PBS INSTRUCTION: 100-26/ PBS Instruction 300-05

Approval Date: 18/09/1983
Revision Date : 19/02/2020

SUBJECT: POWER FACTOR MEASUREMENTS

I. PURPOSE

To determine the Power Factor and steps to be taken in order to improve Power Factor of the Consumers accurately.

II. GENERAL

At the meter end of inductive load consumers, the Power Factor shall be minimum 95% lagging, otherwise penalty shall be imposed as per Rule of BERC. This penalty is meant to encourage the consumer to install necessary capacitors to improve the Power Factor which will benefit both the consumer and the PBS in many ways. Bills shall be adjusted on measurement of Power Factor for all inductive load consumers, Capacitor (Auto PFI Panel) must have been installed for new consumers which will be treated as part of the electrical equipment. Following is the procedure for determining the power factor.

All the Capacitors/Auto PFI units shall be connected in such a way that when motors are put off, the Capacitors/Auto PFI units will be disconnected from the system to avoid leading Power Factor. This connection system will be ensured by Member Service Department and on request by consulting firm engaged for the PBS.

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III. POLICY

A. পাওয়ার ফ্যাক্টর সারচার্জ:

- ক) অনুমোদিত লোড ২০ কি.ও. এর উর্ধ্বের সকল তিন ফেজ এলটি-এ (আবাসিক), এলটি-বি (সেচ/কৃষি কাজে ব্যবহৃত পাম্প), এলটি-সি ১ (ক্ষুদ্র শিল্প), এলটি-ডি ১ (শিক্ষা, ধর্মীয় ও দাতব্য প্রতিষ্ঠান এবং হাসপাতাল) এবং এলটি-ই (বাণিজ্যিক ও অফিস) গ্রাহককে সরবরাহ পয়েন্টে মাসিক গড় পাওয়ার ফ্যাক্টর অবশ্যই ০.৯৫ থেকে ১.০০ এর মধ্যে রাখতে হবে।
- খ) তিন ফেজ সকল এলটি-সি ২ (নির্মাণ), এবং এলটি-ডি ২ রাস্তার বাতি, পানির পাম্প ও ব্যাটারী চার্জিং স্টেশন) এর শুধুমাত্র পানির পাম্প গ্রাহককে সরবরাহ পয়েন্টে মাসিক গড় পাওয়ার ফ্যাক্টর অবশ্যই ০.৯৫ থেকে ১.০০ এর মধ্যে রাখতে হবে।
- গ) সকল এমটি, এইচটি এবং ইএইচটি গ্রাহককে সরবরাহ পয়েন্টে মাসিক গড় পাওয়ার ফ্যাক্টর অবশ্যই ০.৯৫ থেকে ১.০০ এর মধ্যে রাখতে হবে।
- ঘ) উপরে উল্লিখিত গ্রাহকের ক্ষেত্রে সরবরাহ পয়েন্টে মাসিক গড় পাওয়ার ফ্যাক্টর (পিএফ) ০.৯৫ এর কম রেকর্ড হলে নিম্নোক্ত হারে সারচার্জ প্রযোজ্য হবে:
- ১) সরবরাহ পয়েন্টে মাসিক গড় পিএফ ০.৯৫ থেকে পিএফ ০.৭৫ পর্যন্ত প্রতি ০.০১ পিএফ কম এর জন্য গ্রাহকের বিলের এনার্জি চার্জের ওপর ০.৭৫ শতাংশ হারে সারচার্জ প্রযোজ্য হবে।
 - ২) পর পর ৩ (তিন) মাস পাওয়ার ফ্যাক্টর ০.৭৫ এর নীচে নেমে গেলে গ্রাহককে নোটিশ প্রদান করতে হবে এবং চতুর্থ মাসেও পাওয়ার ফ্যাক্টর ০.৭৫ এর নীচে নেমে গেলে গুণগত মানসম্পন্ন বিদ্যুৎ সরবরাহের স্বার্থে গ্রাহকের বিদ্যুৎ সরবরাহ ১৫ (পনের) দিনের নোটিশ প্রদানপূর্বক বিচ্ছিন্ন করা হবে।
 - ৩) উপরে উল্লিখিত কারণে বিচ্ছিন্ন হওয়া গ্রাহককে যথাযথ শুদ্ধকরণ সরঞ্জাম স্থাপন এবং প্রযোজ্য পুনঃসংযোগ চার্জ প্রদান সাপেক্ষে বিদ্যুৎ সংযোগ পুনর্বহাল করা যাবে।

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B. If KVARh meter is installed power factor reading will be measured directly from that meter but the following procedure will be applicable for measuring Power Factor when KVARh meter is not installed:

At consumer end the Power Factor shall have to be maintained at minimum 95% lagging. Assistant General Manager (Member Services) of the PBS shall prepare a schedule under headquarters of PBS for measurement of Power Factor for inductive loads and the name of the person(s) responsible for Power Factor (PF) measurement will be stated in the schedule. Accordingly, Assistant General Manager (O&M) shall prepare the said schedule for Zonal Office and Sub-Zonal Office.

C. Each consumer will be served a notice informing the date of Power Factor measurement. In addition to penalty rates as per PBS Rate Schedule and the minimum Power Factor requirement, the aforesaid notice shall state regarding arrangement of running all electrical installations on full load on the schedule date of Power Factor measurement. The objective of this notice is to persuade the consumer to raise the power factor to the limit as laid down in (A) above before the scheduled day of measuring Power Factor by the PBS.

D. For the purpose of measurement of power factor each team shall be constituted with minimum of two appropriate persons who will be responsible for the assignment of accurate power factor measurement.

- (a) For measurement of power factor of larger loads (MT, HT, EHT), the PBS Senior General Manager/ General Manager must be present on the spot on sample basis.
- (b) Assistant General Manager (Member Service) for Headquarters and Deputy General Manager (Tech-HQ) shall be responsible for all cases of power factor measurement.

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- (c) For Zonal Office, Deputy General Manager and Assistant General Manager (O&M) shall be responsible for all cases of power factor measurement.
- (d) For Sub-Zonal Office, Assistant General Manager (O&M) shall be responsible for all cases of power factor measurement.
- (e) Deputy General Manager (Tech-HQ) shall supervise and ensure (if necessary with counter-checking) power factor measurement of all offices.
- (f) When the PBS deems it necessary, the assistance of System Operation of BREB/ Engineering Consulting firms may be taken.
- E. As per BERC rules average Power Factor will be calculated as per following formula:-
(KWH + KVARH Will be taken from meter reading)

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

Where,

PF = Average Power Factor of the month to be calculated

KWH = Consumed Active Energy of the Month.

= Cumulative KWH Reading of the month – Cumulative KWH Reading of the previous month.

KVARH = Reactive Energy of the month

= Arithmetic Sum of KVARH_{Lagging} & KVARH_{Leading}

= KVARH_{Lagging} + KVARH_{Leading}

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Where-

$KVARH_{Lagging} = \text{Cumulative } KVARH_{Lagging} \text{ Reading of the month} - \text{Cumulative } KVARH_{Lagging} \text{ Reading of the previous month}$

$KVARH_{Leading} = \text{Cumulative } KVARH_{Leading} \text{ Reading of the month} - \text{Cumulative } KVARH_{Leading} \text{ Reading of the previous month.}$

F. Technically qualified PBS officers/ employees will conduct the measurements necessary for determining the power factor. The persons measuring the Power Factor shall ensure accuracy of the watt-hour meters installed at consumer end. During Power Factor measurement, all electrical equipment of the consumers shall have to be operating continuously at full load. The Power Factor shall be measured by a portable Power Factor Meter.

In absence of Power Factor Meter, the Power Factor shall be determined by Voltmeter, Ammeter and Stop-watch method. The three-phase currents and phase-to-phase voltages will be measured with the most accurate ammeter and voltmeter available. More acceptable Power Factor will be available if accurate KVA measuring meter is used. The currents, voltages, and time required for the (10) revolutions of the energy meter disk/ pulses will be measured for consecutive 3 (three) times by using stop watch. The average of these measurements will be utilized in determining the Power Factor.

Two copies of Form as shown in Appendix-A will be used for measuring Power Factor.

For Three Phase Connection:

Apparent Power = $1.73 \times \text{Average Phase Current} \times \text{Average Phase to phase voltage}$

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Real Power = (Meter kh× 3600 × No. of revolutions of meter disk/ Pulse)/Time (second)

Power Factor = Real Power/Apparent Power

For Single Phase Connections:

Apparent Power = Average Phase Current × Average Phase to Neutral voltage.

Real Power = (Meter kh× 3600 × No. of revolutions of meter disk/ Pulse)/Time (second).

Power Factor = Real Power/Apparent Power.

In advance the PBS officers/ employees must be attained thorough practical experience on this procedure of determining Power Factor, and make sure that all equipment used during Power Factor measurement are in working condition.

- G. If the power factor is determined to be less than the aforesaid values penalty as per BERC Rate Schedule shall be imposed from the next month. Imposing of penalty along with the bills shall continue in the same rate till Power Factor is measured next time. If the consumer installs necessary capacitors and notifies the PBS in writing, the consumer shall be informed through a letter setting a date for determining Power Factor once again within 10(ten) days from the date of receipt of letter, The bill of the consumer shall be prepared on the basis of this Power Factor measurement from that month.
- H. PBS shall measure power factor of large loads (HT/MT/EHT consumers) every Six (6) months and other applicable inductive loads every year to ensure that installed capacitors are in working condition. Senior General Manager/General Manager / DGM (Tech-HQ)/DGM (Zonal Office)/AGM (MS)/AGM (O&M)/AGM (E&C)/AGM (P&M) shall

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make sudden visit to assess the power factor. If the power factor such determined is found to be less than the set values, penalty as per rate schedule shall be imposed from the respective month until the power factor should raise aforesaid Value.


- I. Two top sheets shall be prepared by Member Service Department stating Name of the Consumer, Account No., and power factor based on the power factor measurement information. On the following day of power factor measurement, all forms (Appendix-A) along with one copy of top-sheet shall be transmitted to finance department through DGM (Tech-HQ)/DGM (Zonal Office). One copy of the top-sheet shall be maintained in the file of Member Service Department, the other copy in the file of Finance Department and the Appendix-A Form in respective file. However, Senior General Manager/ General Manager shall supervise the activities in the coordination meeting of the PBS.
- J. If any problem is detected in the watt-hour meter during the measurement of Power Factor, the matter shall be intimated through a note-sheet to the concerned section. In case of any confusion arises regarding the accuracy of the meter, Power Factor shall be determined by both by Power Factor meter method and Voltmeter, Ammeter, Stop-watch method. It is possible to ascertain the accuracy of the watt-hour meter by determining Power Factor by both the methods. Stop-watch method is found to be less than the Power Factor measured by Power Factor meter then it is proved that the meter installed at consumer end is running slow. Power factor for constant load shall have to be measured definitely during any measurement of Power Factor.

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BENEFITS TO USERS

Consumer member may inquire about the benefits of installation of capacitors and improvement of power factor. The consumer should be given clear idea about the benefits of improved Power Factor. Following are the benefits to the consumers.

1. Reduces conductor power loss.
2. Reduces voltage drop. As a result of reduced voltage drop motor run smoothly, is not over-heated and has longer life. Good Power Factor protects a motor winding from being burnt due to over-heating.
3. Decreases undesired apparent power being drawn by loads.
4. Reduced System Loss, Motor and wiring will have less system loss, thus reducing KWH consumption and less billing.
5. Increased capacity of feeder and associated equipment.
6. Primary consumer's transformer loss is reduced by 2% (approximate).
7. Protects the consumers from paying penalty each month.

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FORM FOR POWER FACTOR MEASUREMENT

Name of the Consumer :
 Account No. : Book No. :
 Type of Load : Contract Load :
 Date of PF Measurement : Meter No. :

(A) By Power Factor Meters

Sl No	Power Factor of Phase # 1	Power Factor of Phase # 2	Power Factor of Phase # 3	Average Power Factor	Remarks

(B) By Voltmeter, Ammeter and Stop-watch

Sl No	V ₁₋₂ or V _{p-n}	V ₂₋₃	V ₃₋₁	I ₁ or I _L	I ₂	I ₃	Time Taken for 10 Pulse/ Revolution	Meter K _h	Power Factor	Avg. Power Factor

Note: V_{p-n} is Phase to Neutral Voltage and I_L is Line current for Single Phase.

Signature of the Consumer/
Consumer's Representative and Date.

Signature of Power Factor Measuring Personnel
and date

Designation :
Signature and Date of the PBS officer present
Designation :

Distribution 1. Consumer File. 2. Consumer.

Note:- Information in respect of Meter, meter installation and service drop shall only be recorded overleap of Consumer Document Form. (Turn overleap

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1. Condition of Meter installed at Consumer End:
2. Condition of Service Drop & Service Entrance:

Signature of PBS Representative

Name :

Designation :

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