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PUNJAB STATE ELECTRICITY REGULATORY COMMISSION

NOTIFICATION

The 21st March, 2023

No. PSERC/Secy/Regu.-172.—In exercise of powers conferred under section 181 of the Electricity Act, 2003 (36 of 2003) read with section 61, section 57 and section 59 thereof and all other powers enabling it in this behalf, and after previous publication, the Punjab State Electricity Regulatory Commission hereby makes the following regulations, namely:

CHAPTER - 1

PRELIMINARY

1. Short Title, Extent and Commencement

- (1) These regulations may be called the Punjab State Electricity Regulatory Commission (Power Quality) Regulations, 2023.
- (2) These Regulations shall extend to the whole of the State of Punjab.
- (3) These Regulations shall come into force from the date of their publication in the Official Gazette.

Provided that the compensation payable by the distribution licensee for its failure to meet Power Quality standards as per table 15 under chapter 5 of these regulations shall come in to force from the date to be notified separately by the Commission.

2. Definitions and Interpretations.—In these regulations, unless the context otherwise requires -

- (1) ‘Act’ means the Electricity Act, 2003 (36 of 2003);
- (2) ‘Appropriate Forum’ means the Corporate or Zonal or Circle or Divisional Forum constituted by the distribution licensee under sub-section (5) of Section 42 of the Act read with Rule 15 of the Electricity(Rights of Consumers) Rules, 2020, as per the jurisdiction specified in Punjab State Electricity Regulatory Commission (Forum & Ombudsman) Regulations, 2016, as amended from time to time;
- (3) ‘Authority’ means the Central Electricity Authority;

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- (4) **'Consumer'** means any person who is supplied with electricity for his own use by a licensee or the Government or by any other person engaged in the business of supplying electricity to the public under the Act or any other law for the time being in force and includes any person whose premises are for the time being connected for the purpose of receiving electricity with the works of a licensee, the Government or such other person, as the case may be;
 - (5) **'Central Commission'** means the Central Electricity Regulatory Commission;
 - (6) **'Commission'** means the Punjab State Electricity Regulatory Commission;
 - (7) **'Continuous Phenomenon'** means deviations from the nominal value that occur continuously over time;
 - (8) **'Contract Demand'** means the maximum demand in kVA sanctioned to the consumer and computed in the manner as approved by the Commission;
 - (9) **'Declared Supply Voltage (Uc)'** means the voltage at the consumers supply terminals declared by the supplier of electrical energy. Declared supply voltage is usually equal to the nominal voltage (Un);
 - (10) **'Designated Consumers'** means the consumers connected at a supply voltage of 11 kV and above and shall inter alia include the processes/industries such as Arc Furnaces, Induction furnaces, Chloro alkaline units, Billet heaters, Surface hardening Machines, Electrolytic process industries, Electric Bell furnaces for annealing, Electro-slag refining/melting processes, IT/ITES, Malls, Petro-Chemical units, Railway Traction, Pharmaceuticals or as may be specified by the Commission from time to time. The Full Open Access Consumers and deemed licensees covered under above processes/industries using the intra-state transmission and/or distribution system of other licensee to source power through open access shall also be treated as Designated Consumer under these regulations.
 - (11) **'Flicker'** means the impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time. It is caused under certain conditions by voltage fluctuation changing the luminance of lamps;
 - (12) **'Flicker Severity'** means intensity of flicker annoyance evaluated by the following quantities:
 - a) Short term severity (P_{st}) measured over a period of 10 min;
 - b) Long term severity (P_{lt}) calculated from a sequence of twelve P_{st}-values over a 2 hour time interval;
 - (13) **'Frequency'** means the number of alternating cycles per second [expressed in Hertz (Hz)];
 - (14) **'Grid Code'** means the Grid Code as specified by the Punjab State Electricity Regulatory Commission;
 - (15) **'Grid Standards'** means the Grid Standards specified by the Authority;

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- (16) **'Harmonics'** means the sinusoidal component of a periodic wave, either Voltage or Current waveform, having a frequency that is an integral multiple of the fundamental frequency of 50 Hz;
- (17) **'High Voltage'** means the voltage whose nominal root mean square (r.m.s.) value is more than 33000 volts but less than or equal to 150000 volts;
- (18) **'Indian Standards (IS)'** means standards specified by Bureau of Indian Standards;
- (19) **'IEC Standard'** means a standard approved by the International Electrotechnical Commission;
- (20) **'Interconnection Point (Distribution System)'** means a point on the electricity system, including a sub-station or switchyard, where the interconnection is established between the consumer and the electricity system of the distribution licensee and where electricity injected into or drawn from the electricity system can be measured unambiguously for the consumer;
- (21) **'licensee'** means the distribution licensee;
- (22) **'Low Voltage (LV)'** means the voltage whose nominal r.m.s. value is less than or equal to 1000 Volts;
- (23) **'Medium Voltage (MV)'** means the voltage whose nominal r.m.s. value is more than 1000 volts but less than or equal to 33000 volts;
- (24) **'Maximum demand load current'** means the current value at the point of common coupling calculated as the sum of the currents corresponding to the maximum 15/30 minute demand during each of the twelve previous months divided by 12;
- (25) **'Nominal voltage (of the Distribution System) (Un)'** means the value of voltage by which the electrical installation or part of the electrical installation is designated and identified;
- (26) **'Normal Operating Condition'** means operating condition for an electricity network, where generation and load demands meet, system switching operations are concluded, faults are cleared by automatic protection systems and in the absence of:
- i. temporary supply arrangement;
 - ii. exceptional situations such as:
 - a. exceptional weather conditions and other natural disasters;
 - b. force majeure;
 - c. third party interference;
 - d. acts by public authorities;
 - e. industrial actions (subject to legal requirements);
 - f. power shortages resulting from external events

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- (27) **‘Nominal Frequency’** means the frequency of 50.00 Hz of the supply voltage.
- (28) **‘Point of Common Coupling (PCC)’** means the point of metering, or any other point on supply system of distribution licensee, electrically nearest to the particular load at which other loads are, or could be, connected. For service to industrial users (i.e., manufacturing plants) via a dedicated service transformer, the PCC is usually at the HV side of the transformer. For commercial users (office parks, shopping malls, etc.) supplied through a common service transformer, the PCC is commonly at the LV side of the service transformer.
- (29) **‘Power Factor’ or ‘Displacement Power Factor’** means the cosine of the electrical angle between the voltage and current vectors in an AC electric circuit;
- (30) **‘Power Quality Meter’** means a device suitable for monitoring and recording of power quality. It shall be capable of accurate measurement, monitoring and recording of harmonics, sags, swells, flickers and other power quality parameters;
- (31) **‘Rural areas’** mean the areas covered by Gram Panchayats, including major and minor Panchayats;
- (32) **‘r.m.s. (root-mean-square) value’** means square root of the arithmetic mean of the squares of the instantaneous values of a quantity taken over a specified time interval and a specified bandwidth;
- (33) **‘Sanctioned Load or Contracted load’** means load in kilowatt (kW) or Horse Power (BHP) for which the Distribution Licensee had agreed to supply from time to time subject to governing terms and conditions;
- (34) **‘Supply Area’** means the area within which a Distribution Licensee is authorised by his License to supply electricity;
- (35) **‘Supply Terminals’** means point in a distribution system designated as such and contractually fixed, at which electrical energy is exchanged between the Customer and distribution licensee. This point can differ from the electricity metering point or the point of common coupling.
- (36) **‘Supply Voltage’** means the r.m.s. value of the voltage at a given time at the supply terminal, measured over a given interval;
- (37) **‘Supply Voltage Interruption’** is a condition in which the voltage at the supply terminals is lower than 5% of the nominal voltage condition. It can be classified as:
- a) **Planned or Pre-arranged Supply Interruptions** means a supply interruption when network users are informed in advance;
 - b) **Forced or Accidental Supply Interruptions**, caused by permanent or transient faults, mostly related to external events, equipment failures or interference.

An Accidental or forced supply interruption is classified as:

- 1) **Sustained or long interruption** means supply interruption is longer than 3 min;
- 2) **Short interruption** means supply interruption is upto & including 3 min.;
- 3) For poly-phase systems, a supply interruption occurs when the voltage falls below 5% of the nominal voltage on all phases (otherwise, it is considered to be a dip).

- (38) **'Supply voltage dip'** means Temporary reduction of the root mean square (r.m.s.) voltage at a point in the electrical supply system below as specified start threshold.

NOTES

- 1 Application: For the purpose of standard, the dip start threshold is equal to 90 percent of the reference voltage.
- 2 Typically, a dip is associated with the occurrence and termination of a short circuit or other extreme current increase on the system or installations connected to it.
- 3 For the purpose of Standard, a voltage dip is a two dimensional electromagnetic disturbance, the level of which is determined by both voltage and time (duration).

- (39) **'Supply Voltage Dip Duration'** means time between the instant at which the root mean square (r.m.s.) voltage falls below the start threshold and the instant at which it rises to the end threshold.

NOTES

- 1 Application : For the purpose of the standard, the duration of a voltage dip is from 10 ms up to and including 1 min.
- 2 For polyphase events, a dip begins when one voltage falls below the dip start threshold and ends when all voltages are equal to or above the dip end threshold.

- (40) **'Supply Voltage Dip End Threshold'** means Root mean square (r.m.s.) value of the voltage on an electricity supply system specified for the purpose of defining the end of a voltage dip.

- (41) **'Supply Voltage Dip Residual Voltage'** means minimum value of root mean square (r.m.s.) voltage recorded during a voltage dip.

NOTE- For the purpose of this Standard, the residual voltage is expressed as a percentage of the reference voltage.

- (42) **'Supply Voltage Dip Start Threshold'** means Root mean square (r.m.s) value of the voltage specified for the purpose of defining the start of a voltage dip;

- (43) **'Supply voltage swells (temporary Power Frequency Overvoltage)'** means Temporary increase of the root mean square (r.m.s.), voltage at a point in the electricity supply system above a specified start threshold.

NOTES

- 1 Application: For the purpose of Standard, the swell start threshold is equal to 110 percent of the reference voltage.
 - 2 For the purpose of Standard, a voltage swell is a two dimensional electromagnetic disturbance, the level of which is determined by both voltage and time (duration).
 - 3 Voltage swells may appear between live conductors or between live conductors and earth. Depending on the neutral arrangement, faults to ground may also give rise to over voltages between healthy phases and neutral;
- (44) **'Supply voltage swell duration'** means time between the instant at which the root mean square (r.m.s) voltage at a particular point of an electricity supply system exceeds the start threshold and the instant at which it falls below the end threshold.
- NOTE -Application for the purpose of this standard, the duration of a voltage swell is from 10 ms up to and including 1 min.;
- (45) **'Supply voltage swell end threshold'** means r.m.s. value of the supply voltage specified for the purpose of defining the end of a supply voltage swell;
- (46) **'Supply voltage swell start threshold'** means r.m.s. value of the supply voltage specified for the purpose of defining the start of a supply voltage swell;
- (47) **'System Average Interruption Duration Index' (SAIDI)** means the average duration of sustained interruptions per consumer occurring during the reporting period, determined by dividing the sum of all sustained consumer interruptions durations, in minutes, by the total number of consumers;
- (48) **'System Average Interruption Frequency Index' (SAIFI)** means the average frequency of sustained interruptions per consumer occurring during the reporting period, determined by dividing the total number of all sustained consumer interruption by the total number of consumers;
- (49) **'True Power Factor'** means the ratio between total active power used in a circuit (including harmonics) and the total apparent power (including harmonics) supplied from the source. True power factor is always less than displacement power factor if harmonics are present in the system;
- (50) **'Transient over voltages'** means short duration oscillatory or non-oscillatory over voltages usually highly damped and with duration of few ms or in microseconds;
- (51) **'Total Demand Distortion (TDD)'** means the ratio of the root mean square of the harmonic content, considering harmonic components up to the 50th order, expressed as a percent of the maximum demand current;
- (52) **'Total Harmonic Distortion (THD)'** means the ratio of the root mean square of the harmonic content, considering harmonic components up to the 50th order, expressed as a percent of the fundamental;

- (53) **‘Voltage Events’** means sudden and significant deviations from normal or desired wave shape. Voltage events typically occur due to unpredictable events (e.g. faults) or due to external causes (e.g. weather conditions);
- (54) **‘Voltage Fluctuation’ or ‘Voltage Variations’** means series of voltage changes or a cyclic variation of the voltage envelope, the magnitude of which does not normally exceed the specified voltage ranges;
- (55) **‘Voltage unbalance’** means a condition in a poly-phase system in which the r.m.s. values of the line-to-line voltages (fundamental component), or the phase angles between consecutive line voltages, are not all equal. The degree of inequality is usually expressed as the ratios of negative and zero sequence components to the positive sequence component;
- (56) **‘Urban Areas’** means the areas covered by all Municipal Corporations and other Municipalities including the areas falling under the various Urban Development Authorities, Cantonment Authorities and Industrial Estate and Townships including those specified by the Punjab Government;

The words and expressions used in these regulations and not defined herein but defined in the Act or any other regulation of the Commission shall have the meaning assigned to them under the Act or any other regulation of the Commission respectively.

CHAPTER – 2**GENERAL****3. Objectives**

- (1) The Power Quality of the electrical system refers to both the extent of deviation or distortion in pure supply waveform and the continuity of supply. An ideal power supply is never interrupted, always within voltage and frequency tolerances and has a noise free sinusoidal waveform. Poor power quality causes performance degradation and premature failures of electrical equipment. It also results in increased system losses.
- (2) Different type of disturbances that affects the power quality include Harmonics (waveform distortion), voltage unbalance, voltage variations, flicker, supply interruptions, voltage dips and voltage swell etc. Each of these disturbances has different causes and effects.
- (3) Power quality disturbances can propagate upstream or downstream and could affect other customers connected in the same supply network. Power quality monitors are available to measure all aspects of power quality.
- (4) The objective of standards specified in these Regulations is to ensure the quality and reliability of electricity supplied by the distribution licensee to the end consumers and by the designated consumers.
- (5) Any failure by the Distribution Licensee or Designated Consumer to achieve and maintain the power quality parameters specified in these Regulations shall render the Distribution Licensee or Designated Consumer liable to payment of compensation to an affected entity, as approved by the Commission.

4. Assessment of Power Quality

- (1) The assessment of Power Quality shall consist of measuring the various parameters of the power quality and comparing them with the standards specified in these regulations.
- (2) Measurement methods for assessment of Power Quality under these Regulations shall be as per applicable notified IS and in absence of IS, it shall be as per IEC 61000-4-30:2015 namely 'Testing and measurement techniques – Power quality measurement methods' and as amended from time to time.
- (3) For three phase four-wire connections, the line to neutral voltages shall be considered. For three phase three-wire connections the line to line voltages shall be considered. For single phase connections, the supply voltage (line to line or line to neutral, according to the network user connection) shall be considered

5. Scope and extent of application

- (1) These Regulations shall apply to Distribution Licensee(s) including Deemed Distribution Licensee(s), distribution franchisees and the Designated Consumers of electricity in the State as decided by the Commission from time to time

including Full open access consumers, deemed licensee(s) using the intra-state transmission and/or distribution system of other licensee to source power through open access.

Provided that the designated consumers (including Full Open Access consumers & deemed licensee sourcing power through open access) using or engaged in any of the following processes/industries, shall be governed by the provisions of these regulations from the date of the publication of these regulations in the Official Gazette:

Arc Furnaces, Induction furnaces, Chloro-alkaline units, Billet heaters, Surface hardening Machines, Electrolytic process industries, Electric Bell furnaces for annealing, Electro-slag refining/melting processes, Railway traction load connected at 11 kV and above.

Provided further that the designated consumers using and engaged in other processes/industries, as may be decided by the Commission from time to time, shall be governed by the provisions of these regulations from the date as may be notified by the Commission separately.

Provided also that in case of designated consumer using both PIU and General load (mixed load industry), such consumer shall be covered under these Regulations only if the total installed/connected kVA of the PIU load exceeds 100 kVA. Where rating in kVA is not available, the rated load in kW shall be converted in to kVA by using unity power factor.

- (2) The scope of these Regulations is to specify the main characteristics of power quality of electrical supply at point of common coupling (PCC) or at supply terminals of Consumer in distribution system.
 - (a) The characteristics of power quality of electrical supply considered in these Regulations to be controlled by distribution licensee are:
 - i. Supply voltage variations
 - ii. Supply voltage flicker
 - iii. Supply voltage unbalance
 - iv. Supply voltage dips and swells
 - v. Supply voltage harmonics
 - vi. Supply Interruptions
 - (b) The characteristic of power quality of electrical supply considered in these Regulations to be controlled by designated Consumers is:
Current harmonics
- (3) The limits specified in these Regulations for power quality parameters shall apply only under normal operating conditions.

6. Roles and Responsibilities

- (1) Distribution licensee shall be responsible to their consumers for supplying electricity with adequate power quality levels as defined in these Regulations.
- (2) Distribution licensee shall identify strategic locations in their electrical network and install the power quality meters at all such identified locations in a phased manner as may be approved by the Commission to maintain power quality in their supply area.
- (3) Distribution licensee shall identify the designated consumers as specified in these regulations and issue notice as specified in Regulation 13.4 of these regulations. The distribution licensee shall capture the data from PQ meters installed by the consumers each billing month or as may be decided by the Commission.
- (4) The designated consumers shall install power quality meters within the time period as specified in these regulations and shall be responsible to control the current harmonic injection in the transmission/distribution system within the limits specified in these regulations.

7. Redressal of Consumer Complaints with regard to Power Quality: The consumer complaints in relation to the Power Quality shall be redressed in the following manner in accordance with these Regulations as under:

- (1) On receipt of a power quality complaint, the distribution licensee shall demonstrate and satisfy that it meets the requirement of Power Quality standards specified in these Regulations.
- (2) In case of complaint on voltage variations, unbalance and voltage harmonics, distribution licensee shall –
 - i. ensure that the power quality parameters are brought within the specified limits within 5 working days of the receipt of a complaint, provided that the fault is identified to a local problem.
 - ii. ensure that the power quality parameters are brought within the specified limits, within 15 working days of the receipt of a complaint, provided that no expansion/enhancement of the network is involved; and
 - iii. resolve the complaint within 180 days, provided that if up-gradation of the distribution system is required.
- (3) The consumer, who is aggrieved by non-redressal of his grievances of Power Quality, may make a representation for the redressal of his grievance to Appropriate Forum as per PSERC (Forum & Ombudsman) Regulations, 2016, as amended from time to time;
- (4) The cost of the verification shall be borne by the distribution licensee.
- (5) The Appropriate Forum constituted under PSERC (Forum and Ombudsman) Regulations, 2016, as amended from time to time shall be responsible for redressal of all grievances of designated consumers under these regulations.

CHAPTER-3:
STANDARDS OF POWER QUALITY

8. Supply Voltage Variations

(1) The supply voltage variations in LV, MV and HV networks from declared voltage shall comply with Table given below and specified with reference to mean r.m.s. values of supply voltage measured over 10 min.

Table 1 – Supply Voltage Variation Limits for LV Systems Interconnected with Transmission System.

Supply Voltage Characteristic	Reference Time Frame	Limits
Mean r.m.s. value of the supply voltage over 10 min	95% of each period of one week	$U_n \pm 10 \%$
	100% of time	$U_n + 10 \%$ / - 15%

Table 2 – Supply Voltage Variation Limits for MV Systems Interconnected with Transmission System.

Supply Voltage Characteristic	Reference Time Frame	Limits
Mean r.m.s. value of the supply voltage over 10 min	99% of each period of one week	$U_n \pm 10 \%$
	100% of time	$U_n \pm 15 \%$

Table 3 – Supply Voltage Variation Limits for LV and MV Systems not interconnected with Transmission System

Supply Voltage Characteristic	Reference Time Frame	Limits
Mean r.m.s. value of the supply voltage over 10 min	100% of time	$U_n + 10 \%$ / - 15 %

Table 4 – Supply Voltage Variation Limits for HV Systems Interconnected with Transmission system.

Supply Voltage Characteristic	Reference Time Frame	Limits
Mean r.m.s. value of the supply voltage over 10 min	100% of time	$U_n \pm 10 \%$

Provided that:

The measurements shall be undertaken in accordance with applicable notified IS and in absence of IS, IEC 61000-4-30:2015 as amended from time to time;

For statistical evaluation, voltage variations shall be assessed for the period not less than 7 continuous days. The short time 10 min values (measured as per IEC) are

accumulated over periods of one week and the 95th and 99th percentile values (i.e., those values that are exceeded for 5% and 1% of the measurement period) are calculated for each 7-day period for comparison with the recommended limits. The values are measured in normal operating condition.

For poly-phase systems, the voltage variations shall be measured in all phases of supply.

9. Supply Voltage Flicker (P_f)

(1) The voltage flicker shall be assessed in two different severity level:

Long-Term severity (P_{lt}) and Short-Term severity (P_{st}).

Short term severity shall be measured over a period of 10 min and long term severity shall be calculated from a sequence of twelve consecutive P_{st}-values over a 2 hour time interval, according to the following expression:

$$P_{lt} = \sqrt{\sum_{i=1}^{12} \frac{P_{sti}^3}{12}}$$

The permissible Supply Voltage Flicker Severity Limits shall be as under;

Table: 5-Supply Voltage Flicker Severity Limits

Supply Characteristic	Voltage	Reference Limits	Time Frame	Limits
Long term flicker severity P _{lt} caused by voltage fluctuation		95 percent of each period of one week		≤ 1

Provided that:

The measurements shall be undertaken in accordance with IEC 61000-4-30;

For statistical evaluation, voltage flicker shall be assessed for the period not less than 7 continuous days. The short time 10 min values are accumulated over periods of one week and the 95th percentile values (i.e., those values that are exceeded for 5% of the measurement period) are calculated for each 7-day period for comparison with the recommended limits. The values are measured in normal operating condition excluding the time period of a voltage dip.

For poly-phase systems, the voltage flicker shall be measured in all phases of supply.

10. Supply Voltage Unbalance (UB)

(1) The supply voltage unbalance in respect of three phase supply shall be assessed from the ratio of rms value of negative phase sequence component (fundamental) to the rms value of positive phase sequence component (fundamental) of the supply voltage. The supply voltage unbalance shall be maintained less than or equal to 2%

by the distribution licensee.

Provided that:

For statistical evaluation, voltage unbalance shall be assessed for the period not less than 7 continuous days. The short time 10 min values are accumulated over periods of one week and the 95th percentile values (i.e., those values that are exceeded for 5% of the measurement period) are calculated for each 7-day period for comparison with the recommended limits. The values are measured in normal operating condition.

11. Voltage Dip or Sag

- (1) The Supply voltage dips shall comply with Table given below and are specified with reference to:
- Number of events per year
 - Event duration (t)
 - Residual Voltage (u)
 - Declared voltage (Uc)

Table 6: Supply Voltage Dip Limits for LV and MV Networks in Terms of Number of Events per Year

Residual Voltage (%)	Duration t (ms)				
	$10 \leq t \leq 200$	$200 < t \leq 500$	$500 < t \leq 1000$	$1000 < t \leq 5000$	$5000 < t \leq 60000$
$90 > u \geq 80$	30	40	10	5	5
$80 > u \geq 70$	30	40	5	5	5
$70 > u \geq 40$	10	40	5	5	5
$40 > u \geq 5$	5	20	5	5	5

Provided that the Supply Voltage dip limits for HV network shall be as may be notified in IS:17036;

Provided further that the voltage dips shall be measured in accordance with IEC 61000-4-30 and shall not fall outside the duration from 10 ms up to and including 1 min;

Provided also that the voltage dips shall be measured in all phases of supply.

12. Voltage Swells

- (1) The Supply voltage swell are specified with reference to:
- Number of events per year
 - Event duration (t)
 - Swell Voltage (u)
 - Declared voltage (Uc)

Supply Voltage swell Limits in Terms of Number of Events per Year shall be as per EN 50160/IEC/IEEE standards till the time BIS notifies the limits in IS 17036 standards

The voltage swell shall be measured in accordance with IEC 61000-4-30 and shall not fall outside the duration from 10 ms up to and including 1 min;

The voltage swell shall be measured in all phases of supply.

13. HARMONICS

- 13.1 The distribution licensee and the designated consumers shall control the harmonics level at the Point of Common Coupling (PCC). The limits of voltage harmonics by the distribution licensee in its electrical network, the limit of injection of current harmonics by the designated consumers, Point of measurement i.e PCC and other related matters shall be as per the IEEE 519-2014 namely 'IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems', as amended from time to time.
- 13.2 Measuring and metering of harmonics shall be a continuous process with meter complying with latest IEC 61000-4-30 class A meter.
- 13.3 The data measured and metered as mentioned in regulation 13.2 with regard to the harmonics, shall be captured by the distribution licensee each month or as may be decided by the Commission from time to time keeping in view the operational constraints. The data shall also be shared with the consumer.
- 13.4 The distribution licensee shall issue notice to the individual designated consumers, as specified in first proviso to clause (1) of Regulation 5 of these regulations, within 15 days from the date of notification of these regulations apprising such consumers of the provisions of these regulations and their obligation to install PQ meters/control current harmonic injection within the specified time. The designated consumers, as specified in first proviso to clause (1) of Regulation 5 of these regulations, shall install the PQ meters within six (6) months from the date of issue of notification of these regulations.

Provided that all the applicants covered under the category of designated consumers, as specified in first proviso to clause (1) of Regulation 5 of these regulations, seeking new connection or extension in demand shall install the PQ meters before the release of connection or extension in demand.

- 13.5 In case the designated consumer, as specified in first proviso to clause (1) of Regulation 5 of these regulations, fails to install power quality meter within the stipulated time, as specified in regulation 13.4 of these regulations, a 15 days' notice shall be issued to such designated consumer by the distribution licensee and thereafter, in case the non-compliance continues then a penalty at the rate of Rs. 50/kVA/month on the sanctioned contract demand or contracted demand under Open Access, as may be applicable, shall be levied. Part of the month shall be treated as full month.

Provided that in case the designated consumer, as specified in first proviso to clause (1) of Regulation 5 of these regulations, fails to install PQ meter even after 9 months from the date of issue of notification of these regulations, then a penalty at the rate of Rs. 80/kVA/month on the sanctioned contract demand or contracted demand under Open Access, as may be applicable, shall be levied.

Provided further that in case the designated consumer, as specified in first proviso to clause (1) of Regulation 5 of these regulations, fails to install PQ meter by 31st March 2024 then such consumer shall be liable to pay compensation @ 10% of the total monthly consumption charges (fixed and energy charges) till installation of PQ meter. After installation of PQ meter by the consumer, in case the TDD values exceeds the specified limits then compensation as specified in Regulation 13.11 of these regulations shall be payable by the consumer.

Provided also that the compensation shall be without prejudice to the distribution licensee right to disconnect the connection/connectivity, as the case may be, after serving a minimum of 15 days notice to the consumer.

- 13.6 The distribution licensee shall install power quality meters in a phased manner covering at least 20% of the total identified locations on 11/33/66 kV feeders, as may be approved by the Commission, within a period of one year from the date of notification of these regulations. The mechanism for capturing and measuring the power quality parameters of remaining identified locations and the timelines shall be decided by the Commission after analysis of the data of PQ meters installed in the first phase.

13.7 Harmonic limits

Harmonic management in a power system is a joint responsibility involving both the end users and the distribution licensee, therefore harmonic limits are specified for both voltages and currents. The limits as mentioned below shall apply only at the Point of Common Coupling (PCC).

13.7.1 VOLTAGE HARMONICS

- (a) The distribution licensee shall control the line-to-neutral voltage harmonics at the Point of Common Coupling. The voltage harmonic distortion of the supply voltage shall be assessed in terms of the Total Harmonic Distortion (THD_V) considering harmonic components up to the 50th order. THD_V shall be taken as square root of the sum of squares of all voltage harmonics expressed as a percentage of the magnitude of the fundamental measured with following formula

$$\text{THD}_V = \sqrt{\sum_{h=2}^N V_h^2}$$

where

V_h represents the percent r.m.s value of the h^{th} harmonic voltage component, and N represents the highest harmonic order considered in the calculation.

(b) Voltage distortion limits

The distribution licensee shall limit the values of THD_v measured at the Point of Common Coupling (PCC) to the values specified under table 7 below;

Table 7

Bus Voltage V at PCC	Individual harmonic (%)	Total harmonic distortion (THD) (%)
$V \leq 1.0 \text{ kV}$	5.0	8.0
$1 \text{ kV} < V \leq 69 \text{ kV}$	3.0	5.0
$69 \text{ kV} < V \leq 161 \text{ kV}$	1.5	2.5
$161 \text{ kV} < V$	1.0	1.5 ^a

^aHigh-voltage systems can have up to 2.0% THD where the cause is an HVDC terminal whose effects will have attenuated at points in the network where future users may be connected.

Statistical Evaluation

For statistical evaluation, voltage harmonics shall be assessed for a period of not less than 7 continuous days. The short time 10 min. values are accumulated over periods of one week and the 95th percentile values (i.e., those values that are exceeded for 5% of the measurement period) are calculated for each 7-day period for comparison with the recommended limits and these values should be less than the values given in table 7. The values are measured at PCC in normal operating condition.

13.7.2 CURRENT HARMONICS

The designated consumer shall limit the value of current harmonics measured at Point of Common Coupling (PCC) measured over 10 min. period to the values as given in tables below:

(a) Current distortion limits (TDD) for system nominally rated through 120 V to 69 kV**Table 8**

Maximum harmonic current distortion in percent of I_L						
Individual harmonic order (odd harmonics) ^{a, b}						
I_{SC}/I_L	$3 \leq h < 11$	$11 \leq h < 17$	$17 \leq h < 23$	$23 \leq h < 35$	$35 \leq h \leq 50$	TDD
<20*	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0

>1000	15.0	7.0	6.0	2.5	1.4	20.0
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Note: * All power generation equipment is limited to these values of current distortion, regardless of actual I_{sc}/I_L ;

*Even harmonics are limited to 25% of the odd harmonic limits above;

^bCurrent distortions that result in a dc offset, e.g., half-wave converters, are not allowed;

where

I_{sc} = maximum short-circuit current at PCC;

I_L = maximum demand load current (fundamental frequency component) at the PCC under normal load operating conditions;

- (b) **Values of Current distortion limits (TDD) for system rated above 69 kV through 161 kV**

Table 9

Maximum harmonic current distortion in percent of I_L						
Individual harmonic order (odd harmonics)^{a, b}						
I_{sc}/I_L	$3 \leq h < 11$	$11 \leq h < 17$	$17 \leq h < 23$	$23 \leq h < 35$	$35 \leq h \leq 50$	TDD
<20*	2.0	1.0	0.75	0.3	0.15	2.5
20<50	3.5	1.75	1.25	0.5	0.25	4.0
50<100	5.0	2.25	2.0	0.75	0.35	6.0
100<1000	6.0	2.75	2.5	1.0	0.5	7.5
>1000	7.5	3.5	3.0	1.25	0.7	10.0

Note: * All power generation equipment is limited to these values of current distortion, regardless of actual I_{sc}/I_L ;

*Even harmonics are limited to 25% of the odd harmonic limits above;

^bCurrent distortions that result in a dc offset, e.g., half-wave converters, are not allowed;

where

I_{sc} = maximum short-circuit current at PCC;

I_L = maximum demand load current (fundamental frequency component) at the PCC under normal load operating conditions;

- (c) **Values of Current distortion limits (TDD) for system rated above 161 kV**

Table 10

Maximum harmonic current distortion in percent of I_L						
Individual harmonic order (odd harmonics) a, b						
I_{sc}/I_L	$3 \leq h < 11$	$11 \leq h < 17$	$17 \leq h < 23$	$23 \leq h < 35$	$35 \leq h \leq 50$	TDD
<25*	1.0	0.5	0.38	0.15	0.1	1.5
25<50	2.0	1.0	0.75	0.3	0.15	2.5
>50	3.0	1.5	1.15	0.45	0.22	3.75

Note: * All power generation equipment is limited to these values of current distortion, regardless of actual ISC/IL;

*Even harmonics are limited to 25% of the odd harmonic limits above;

^bCurrent distortions that result in a dc offset, e.g., half-wave converters, are not allowed;

where

I_{sc} = maximum short-circuit current at PCC;

I_L = maximum demand load current (fundamental frequency component) at the PCC under normal load operating conditions;

Statistical Evaluation

For statistical evaluation, current harmonics shall be assessed for the period not less than 7 continuous days. The short time 10 min values are accumulated over periods of one week and the 95th & 99th percentile values (i.e., those values that are exceeded for 5% and 1% of the measurement period) are calculated for each 7- day period for comparison with the recommended limits.

The weekly 95th percentile short time 10 min harmonic current values should be less than the value given in Table (8), (9) and (10) above, as applicable. However, the weekly 99th percentile short time 10 min harmonic current values should be less than 1.5 times the value given in Table (8), (9) and (10) above, as applicable . The values of TDD are measured at PCC in normal operating condition.

- 13.8 After the installation of PQ meter, the designated consumers shall capture the current harmonics data at the PCC and take necessary remedial measures to limit the current harmonic injection within the limits specified in Regulation 13.7.2 above latest by 31st March, 2024. With effect from 1st April 2024, all the designated consumers, as specified in first proviso to clause (1) of Regulation 5 of these regulations, shall be liable for payment of compensation to distribution licensee as per the provisions of Regulation 13.11 in case the Total Demand Distortion (TDD) values exceeds the limits specified in Regulation 13.7.2 of these regulations.

Provided that a designated consumer may opt to be governed by the provisions of Regulation 13.11 before 1st April 2024 by submitting fresh A&A form under General Category consumer. In such a case, the designated industrial consumer shall be treated as General Industrial category consumer for all intents and purposes from the billing month immediately following the date of receipt of such option along with A&A form by the distribution licensee from the consumer. The A&A form shall be deemed to have been approved from the date of submission to the distribution licensee.

Provided further that option once exercised by the designated consumer shall be final and he shall not be eligible to opt out.

- 13.9 The compensation shall be without prejudice to the right of the distribution licensee to disconnect the connection as per the provisions of CEA (Technical Standards for connectivity to the Grid) Regulations, 2007, as amended from time to time and CEA (Technical Standards for connectivity below 33 kV) (Amendment)) Regulations, 2019, as may be applicable, or the connectivity granted under open access under intimation to the Commission.
- 13.10 The short time (10 min, interval) Total Demand Distortion (TDD) values shall be

accumulated over a period of one week, as specified above. The measured values shall be compared with the values specified in Regulation 13.7.2, as may be applicable. With effect from 1st April 2024 or as may be opted by the consumer as per 1st proviso to Regulation 13.8 above, in case the measured TDD value exceeds the limits specified above during any measurement period of 7 continuous days completed during a billing month then the consumer shall be liable to compensate the distribution licensee in the manner as specified in Regulation 13.11 of these regulations.

- 13.11 The highest excess TDD value over and above the specified limits from amongst the weekly 99th percentile short time (10 min.) and weekly 95th percentile short time (10 min.) current harmonic values during 7 continuous days measurement period completed during a billing month shall be considered for calculating the compensation.
- 13.11.1 In case of designated consumers other than Full Open Access consumer and deemed licensee using transmission &/or distribution system of other licensee for sourcing power through open access, a compensation of a maximum of 10 % of the monthly consumption charges (fixed plus energy charges but without levies) shall be payable by the designated consumer to the distribution licensee in steps as specified in table 11 below

Table 11: Compensation by designated Consumer (Other than Full Open Access consumer and deemed licensee using transmission &/or distribution system of other licensee for sourcing power through open access) for exceeding TDD Limit

TDD excess over and above the limit	Compensation on the monthly consumption charges (fixed + energy charges)(in %age)
Upto 2%	1%
Above 2% but upto 4%	2%
Above 4% but upto 6%	3%
Above 6% but upto 8%	4%
Above 8% but upto 10%	5%
Above 10% but upto 15%	6%
Above 15% but upto 20%	7%
Above 20% but upto 25%	8%
Above 25% but upto 30%	9%
Above 30%	10%

- 13.11.2 In case of Full Open Access consumer or deemed licensee using transmission &/or distribution system of other licensee for sourcing power through open access, a compensation of a maximum of 75 paise per unit of energy consumed through open access shall be payable to distribution licensee in steps as specified in table 12 below;

Table 12: Compensation by designated Consumer (Full Open Access consumer and deemed licensee using transmission &/or distribution system of other licensee for sourcing power through open access) for exceeding TDD Limit

TDD excess over and above the limit	Compensation on the monthly energy consumed through open access (Paise/kWh)
Upto 2%	10
Above 2% but upto 4%	15
Above 4% but upto 6%	22
Above 6% but upto 8%	30
Above 8% but upto 10%	37
Above 10% but upto 15%	45
Above 15% but upto 20%	52
Above 20% but upto 25%	60
Above 25% but upto 30%	67
Above 30%	75

Provided that in case the TDD values during any subsequent billing month during the financial year exceeds the limits specified in Regulation 13.7.2, the consumer shall also be issued a notice by the distribution licensee to take necessary remedial measures to bring the TDD values within the specified limits. After the expiry of 12 months, in case the default still continues, the connection/connectivity of such designated consumer shall be liable to be disconnected. The connection shall be reconnected after the designated consumer gives an undertaking that necessary remedial measures have been taken and the current harmonics injection is within specified limits.

- 13.12 In case the voltage harmonics in the distribution system exceeds the limits specified in regulation 13.7.1 above, the distribution licensee shall be liable to compensate the affected consumers of the feeder(s), after the stipulated date, at the rate and in the manner as approved by the Commission from time to time.

14 Short Supply Voltage Interruptions

- (1) Short voltage interruptions shall comply with Table given below and are specified with reference to:
- i. Number of events per year
 - ii. Event duration (t)
 - iii. Declared voltage (Uc)

Table 13: Short Supply Voltage Interruptions Limits (number of events per year) for LV and MV Networks.

Residual Voltage (%)	Duration t (ms)				
	$10 \leq t \leq 200$	$200 < t \leq 500$	$500 < t \leq 1000$	$1000 < t \leq 5000$	$5000 < t \leq 60000$
$5 > u$	5	20	30	10	10

Provided that Short Voltage Interruptions Limits for HV network shall be as may be specified by BIS;

Provided further that the short voltage interruptions shall be measured in accordance with IEC 61000-4-30 and shall not fall outside the duration from 10 ms up to and including 1 min;

15 Long or Sustained Supply Voltage Interruptions

- (1) The Distribution Licensee shall calculate the reliability of its distribution system on the basis of number and duration of sustained or long supply voltage interruptions (longer than 3 min) in a reporting period, using the following indices:
 - i. System Average Interruption Frequency Index (SAIFI);
 - ii. System Average Interruption Duration Index (SAIDI);
- (2) The Indices shall be computed for the distribution licensees for each month for all the 11kV and 66/33kV feeders in the supply area, and then aggregating the number and duration of all interruptions in that month for each feeder. The Indices shall be computed using the following formulae:

$$SAIFI = \frac{\sum_{i=1}^n A_i * N_i}{N_t}$$

$$SAIDI = \frac{\sum_{i=1}^n B_i * N_i}{N_t}$$

Where

A_i = Total number of sustained interruptions (each longer than 3 min) on i^{th} feeder for the month;

B_i = Total duration in minutes of all sustained interruptions (longer than 3 min) on i^{th} feeder for the month;

N_i = Number of Customers on i^{th} feeder affected due to each sustained interruption;

N_t = Total number of customers served by the Distribution Licensee in the supply area;

n = number of 11kV and 66/33kV feeders in the licensed area of supply;

- (3) The distribution licensee shall maintain the reliability on monthly basis within the limits specified in table below:

Table 14: Limits for Reliability indices

Reliability Indices	Limits		
	Urban		RURAL
SAIDI	600 Minutes per customer	per	900 Minutes per customer
SAIFI	15 interruptions per customer	per	25 interruptions per customer

Provided that:

The feeders must be segregated into rural and urban and the value of the indices must be reported separately for each month.

While calculating the given reliability indices, the following types of interruptions shall not be taken into account:

- i. Momentary outages of duration less than three minutes.
- ii. Outages due to Force Majeure events such as cyclone, floods, storms, war, mutiny, civil commotion, riots, lightning, earthquake, lockout, grid failure, fire affecting licensee's installations and activities;
- iii. Outages that are initiated by the National Load Despatch Centre/ Regional Load Despatch Centre/State Load Despatch Centre during the occurrence of failure of their facilities;

While calculating the given reliability indices, the interruptions due to scheduled or planned outages shall be taken into account.

The distribution licensee shall capture reliability indices data directly from the feeder monitoring system and there should not be any manual interventions as far as possible.

The Distribution Licensee shall maintain data on the reliability indices specified above for each zone/circle/division/sub-division on a monthly basis.

The Distribution Licensee shall put up, at the end of each month, such monthly information on reliability indices, on website of the Distribution Licensee and shall submit such report quarterly to the Commission.

CHAPTER – 4**MONITORING AND REPORTING OF THE POWER QUALITY****16 Monitoring of Power Quality**

- (1) The distribution licensee for the purpose of requirements for the quality of electricity supplied shall identify the locations of 66kV/33kV/11kV feeders, and designated consumers to ensure the measurement of the power quality parameters at sufficient locations in their electrical networks to adequately characterize and report performance in terms of these Regulations. The feeders shall be identified for PQ monitoring based on type of load connected with the approval of the Commission.
- (2) PQ measurement shall be implemented by the distribution licensee in a phased manner so as to complete the task of installation of PQ meters at all identified locations within the timelines approved by the Commission. In the first phase, the distribution licensee shall install Power Quality meters on 20% of the identified locations on 11/33/66 kV feeders. All designated consumers shall install the PQ meters as specified in Regulation 13.4 of these regulations at point of common coupling (PCC).
- (3) The distribution licensee shall enforce the continuous monitoring of power quality standards at the inter-connection point of identified locations at or below 66 kV voltage level for development of profile of power quality measurement in the area of supply;
- (4) The measurements undertaken to determine compliance shall be carried out in accordance with the requirements as specified in IEC 61000-4-7 and IEC 61000-4-30. There shall be continuous metering of harmonics with permanent Power Quality meters complying with the IEC 61000-4-30 Class-A meters.
- (5) In the event when the distribution licensee receives a customer complaint concerning Power Quality, the distribution licensee shall, after due verification, deploy power quality meter for a particular period for the purpose of capturing the power quality data. Distribution licensee can also measure the level of harmonics generation at PCC of any consumer(s) on receipt of complaint(s) from other affected consumer(s).
- (6) These Regulations specifies the minimum requirements for Power Quality meters for measurement at sites directly affecting the quality of the power supplied to the consumer(s). The distribution licensee may require the additional PQ meters to establish the power quality at other bulk supply points and at other major network nodes and to investigate consumer(s) complaints, for which these additional PQ meters may be installed temporarily.
- (7) The distribution licensee may opt to integrate the smart grid meters compatible for measurement of the PQ parameters for economic and operational optimization.

17 Compliance of the Power Quality and Reliability Standards

- (1) The distribution licensee shall submit the quarterly report of information collected on PQ parameters extracted from power quality meters and machine based reliability data in standard formats (as specified separately) to the Commission.
- (2) The designated consumer shall install power quality meter and shall be responsible to control the current harmonic injection in the transmission/distribution system within the limits specified in these regulations. Although the compensation shall be payable in case TDD value exceeds the limits but the designated consumer shall also be responsible to ensure that individual harmonic injection values also remains within the limits specified in these regulations. The distribution licensee shall capture the data from PQ meters each billing month or as may be decided by the Commission.
- (3) It shall be the prime responsibility of the distribution licensee to comply with these Regulations and submit the compliance report every 3 months in standard formats (as specified separately), including transparent data disclosure regarding electrical system, to the Commission. Commission may direct designated agencies to be notified separately, to carry out PQ audit on the basis of compliance reports filed by distribution licensee for verification. The distribution company shall carry out 100% audit by itself once a year and 5% random audit by the independent agency and shall file the audit report along with ARR truing up petition.
- (4) The distribution licensee shall publish the reports indicating the compliance with the standards under these Regulations and post all the reports on its website. The distribution licensee shall also seek comments, if any, on the same from the customers availing supply from the distribution licensee.
- (5) The Commission from time to time may seek reports on PQ improvements from distribution licensee.
- (6) The distribution licensee shall make efforts to improve power quality in their supply area by deploying devices to mitigate power quality issues such as filters or controllers etc. The expenses incurred towards deploying these devices by the distribution licensee shall be considered in the ARR.
- (7) The distribution companies shall ensure the data security and the data should only be used for identified purpose and should not be transferred to any other person without the consent of the specific consumer.

CHAPTER – 5**COMPENSATION MECHANISM FOR POWER QUALITY****18 Compensation mechanism for Power Quality**

- (1) During the first year after notification of Power Quality Regulations, there shall be monitoring and reporting of power quality parameters by distribution licensee in prescribed standard formats at regular intervals. The incentive/dis-incentive for the stakeholders shall come in to force from the date as may be specified by the Commission.
- (2) The expenses incurred towards implementation and monitoring of power quality parameters by the distribution licensee shall be considered in the ARR.
- (3) The Distribution Licensee shall compensate the affected person(s) in second-next billing cycle. In case the Distribution Licensee fails to pay the compensation or if the affected person is aggrieved by non-redressal of his grievances, he may make a representation for the redressal of his grievance to the Appropriate Forum.

Provided that such compensation shall be based on the classification of such failure as determined by the Commission and the payment of such compensation shall be paid or adjusted in the consumer's future bills (issued subsequent to the award of compensation) within thirty (30) days of a direction issued by the Appropriate Forum or by the Ombudsman, as the case may be.

- (4) The Distribution Licensee shall not be excused from failure to maintain the power quality parameters under these Regulations, where such failure can be attributed to negligence or deficiency or lack of preventive maintenance of the distribution system or failure to take reasonable precaution on the part of the Distribution Licensee.
- (5) In case the designated consumer fails to install power quality meter within the stipulated time, as specified in regulation 13.4 of these regulations, such consumer shall be liable for penalty as specified in Regulation 13.5 of these regulations. In case the designated consumer fails to limit the injection of current harmonics within limits specified in Regulation 13.7.2 within the time specified in regulation 13.8 of these regulations, such consumers shall be liable to compensate the distribution licensee in the manner as specified in Regulation 13.11. The compensation shall be without prejudice to the right of the distribution licensee to disconnect the connection as per the provisions of CEA (Technical Standards for connectivity to the Grid) Regulations, 2007, as amended from time to time and CEA (Technical Standards for connectivity below 33 kV) (Amendment) Regulations, 2019, as may be applicable
- (6) Level of compensation payable by the distribution licensee for failure to meet power quality standards are given in table below:

Table 15: Level of compensation

PQ Parameter	Standard	Compensation Payable	Compensation Payable by
Voltage Variation	As per Table-1,2,3 and 4	Rs.100/- per week for which voltage variation was beyond the specified limits. Part of the week shall be treated as one week for this purpose.	Distribution Licensee to each consumer connected on the feeder. These compensations shall be cumulative for each violation.
Voltage unbalance	$V_{unbalance} \leq 2\%$	Rs.100/- per week for which voltage unbalance was beyond the specified limits. Part of the week shall be treated as one week for this purpose.	
Voltage dips or swells	Number of events per year as per Table- 6	Rs.50/- per event for which voltage dips or swell was beyond the specified limits	
Voltage Harmonics	As per Table - 7	Rs.100/- per week for which voltage harmonics was beyond the specified limits. Part of the week shall be treated as one week for this purpose.	
Short Supply Voltage Interruptions	Number of events per year as per Table- 13	Rs.50/- per instance for which short supply voltage interruptions was beyond the specified limits	
Long Supply Voltage Interruptions	SAIDI in Minutes per Consumer as per Table- 14	5 paisa/min/kW or kVA, as applicable, for which SAIDI was beyond the specified limits	
Long Supply Voltage Interruptions	SAIFI in interruption per customer as per Table- 14	Rs.50/- per interruption for which SAIFI was beyond the specified limits	

Provided that such compensation as given in above Table-15 shall not be claimed in ARR by distribution licensee.

CHAPTER – 6**MISCELLANEOUS PROVISIONS**

- 19 **Power to Relax.** The Commission, for reasons to be recorded in writing, may relax any of the provisions of these regulations on its own motion or on an application made before it by an interested person.
20. **Power to Remove Difficulty:** If any difficulty arises in giving effect to the provisions of these regulations, the Commission may, by order, make such provision not inconsistent with the provisions of the Act or provisions of other regulations specified by the Commission, as may appear to be necessary for removing the difficulty in giving effect to the objectives of these regulations.
21. **Issue of orders and practice directions:-**
Subject to the provisions of the Act and these Regulations, the Commission may, from time to time, issue orders and practice directions in regard to the implementation of the Regulations and procedure to be followed on various matters which the Commission has been empowered by these Regulations to lay down.

Sd/-

Secretary to the Commission