MEGHALAYA STATE ELECTRICITY REGULATORY COMMISSION

SHILLONG

Date: 24:09:2018

NOTIFICATION

DRAFT - No.MSERC/POWER-QUALITY/REGULATIONS/2018/04: 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, the Meghalaya State Electricity Regulatory Commission hereby makes the following regulations, for previous publication namely:

CHAPTER - 1

PRELIMINARY

1. Short Title, Extent and Commencement

(1) These regulations may be called the Meghalaya State Electricity Regulatory Commission (Power Quality) Regulations, 2018;

(2) These Regulations shall extend to the whole of the Meghalaya.

(3) These Regulations shall come into force from the date of their publication in the Official Gazette.

2. Definitions and Interpretations.–In these regulations, unless the contextotherwise requires -

(1) **'Act'** means the Electricity Act, 2003 (36 of 2003);

(2) '**Authority'** means the Central Electricity Authority;

(3) **'Consumer'** means any person who is supplied with electricity for his own useby 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;

(4) **'Central Commission'** means the Central Electricity Regulatory Commission;

(5) **'Commission'** means the MeghalayaState Electricity Regulatory Commission;

(6) **'Continuous Phenomenon'** means deviations from the nominal value thatoccur continuously over time;

(7) **'Contract Demand'** means demand in kilowatt (kW)/kilovolt ampere(kVA)/Horse Power (HP) as mutually agreed between Distribution Licensee and the Consumer and as entered into in the

agreement for which Distribution Licensee makes specific commitment to supply from time to in accordance with the governing terms and conditions contained therein or equal to the sanctioned load, where the contract demand has not been provided through /in the agreement;

(8) **'Declared Supply Voltage (Uc)'** means the voltage at the consumers supplyterminals declared by the supplier of electrical energy. Declared supply voltage is usually equal to the nominal voltage;

(9) **'Designated Customers'** means the customers identified as major powerquality polluters due to their installed non-linear loads or generation or otherwise under these Regulations and shall interalia include commercial buildings (Healthcare, Hotels, Airports, malls etc.), IT/ITES and Banking, Finance & Service Industries (BFSI), Automobiles, Iron & Steel, Aluminium, Textile, Paper & Pulp, Chlor-Alkali, Petro-Chemical, Cement, Pharmaceuticals, Fertiliser, Food Processing, Plastic & Rubber and Railways/Metros, grid connected distributed generating resource and Electric Vehicle Charging infrastructure etc.;

(10) **'Flicker'** means the impression of unsteadiness of visual sensation induced by alight stimulus whose luminance or spectral distribution fluctuates with time. It is caused under certain conditions by voltage fluctuation changing the luminance of lamps;

(11) **'Flicker Severity'** means intensity of flicker annoyance evaluated by thefollowing 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;

(12) **'Forum'** means as defined under Meghalaya State Electricity Regulatory Commission(Consumer Grievance Redressal Forum & Electricity Ombudsman) Regulations including any amendment thereto in force from time to time ;

(13) **'Frequency'** means the number of alternating cycles per second [expressed inHertz (Hz)];

(14) **'Grid Code'** means the Grid/Distribution Code as specified by the Meghalaya StateElectricity Regulatory Commission;

(15) **'Grid Standards'** means the Grid Standards specified by the Authority;

(16) **'Harmonics'** means the sinusoidal component of a periodic wave, eitherVoltage 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 r.m.s. value is more than33000 volts but less than or equal to 150000 volts as per IS 12360:1988 standard;

(18) **'Indian Standards (IS)'** means standards specified by Bureau of IndianStandards;

(19) **'IEC Standard'** means a standard approved by the InternationalElectrotechnical Commission;

(20) **'Interconnection Point (Distribution System)'** a point on the electricity system,including a sub-station or switchyard, where the interconnection is established between the customer 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 customer;

(21) **'licensee'** means the distribution licensee;

(22) **'Low Voltage (LV)'** means the voltage whose nominal r.m.s. value is less thanor equal to 1000 Volts as per IS 12360:1988 standard;

(23) **'Medium Voltage (MV)'** means the voltage whose nominal r.m.s. value ismore than 1000 volts but less than or equal to 33000 volts as per IS 12360:1988 standard;

(24) **'Maximum demand load current'** means the current value at the point ofcommon coupling calculated as the sum of the currents corresponding to the maximum 15 minute demand during each of the twelve previous months divided by 12;

(25) **'Nominal voltage (of the Distribution System) (Un)'** means the value ofvoltage by which the electrical installation or part of the electrical installation is designated and identified;

(26) **'Normal Operating Condition' means o**perating condition for an electricitynetwork, 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

(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 otherpoint 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 theelectrical 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 andminor Panchayats;

(32) **'r.m.s. (root-mean-square) value'** means square root of the arithmetic mean ofthe squares of the instantaneous values of a quantity taken over a specified time interval and a specified bandwidth;

(33) **'Sanctioned load'** means load in kilowatt (kW)/kilovolt ampere (kVA)/HorsePower (HP) 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 isauthorised by his License to supply electricity;

(35) **'Supply Terminals'** means point in a distribution system designated as suchand 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 thesupply terminal, measured over a given interval;

(37) **'Supply Voltage Interruption'** is a condition in which the voltage at the supplyterminals is completely lost or lower than 10% of the nominal voltage condition. It can be classified as:

a) **Planned or Prearranged Supply Interruptions** means a supplyinterruption when network users are informed in advance;

b) **Forced or Accidental Supply Interruptions**, caused by permanent ortransient faults, mostly related to external events, equipment failures or interference.

c) A Planned or forced supply interruption is classified as:

1) **Sustained or long interruption** means supply interruption is longerthan 3 min;

2) **Short interruption** means supply interruption is from 20ms to 3 min;

d) For poly-phase systems, a supply interruption occurs when the voltage falls below 10% of the nominal voltage on all phases (otherwise, it is considered to be a dip).

(38) **'Supply voltage dip'** means a temporary reduction of the r.m.s. supply voltageat a given point in the electrical supply system of 10 to 90% of the declared voltage for a duration from 10 ms up to and including 1 min. Typically a dip is associated with the occurrence and termination of a short-circuit or other extreme current increase on the system or installation connected to it;

(39) **'Supply voltage dip duration'** means time between the instant at which ther.m.s. voltage falls below the start threshold and the instant at which it rises to the end threshold. For poly-phase 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 r.m.s. value of the supply voltagespecified for the purpose of defining the end of a supply voltage dip;

(41) **'Supply voltage dip start threshold'** means r.m.s. value of the supply voltagespecified for the purpose of defining the start of a supply voltage dip;

(42) **'Supply voltage dip Residual Voltage'** means minimum value of r.m.s. voltagerecorded during a voltage dip;

(43) **'Supply voltage swells (temporary Power Frequency Overvoltage)**' meanstemporary increase in the r.m.s. supply voltage at a given point in the electrical supply system above 110 of the declared voltage for a duration from 10 ms up to and including 1 min;

(44) **'Supply voltage swell duration'** means time between the instant at which ther.m.s. voltage exceed the start threshold and the instant at which it falls below the end threshold;

(45) **'Supply voltage swell end threshold'** means r.m.s. value of the supply voltagespecified 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 voltagespecified 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 averagefrequency 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 acircuit (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-oscillatoryover 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 ofthe harmonic content, considering harmonic components up to the 50th order, expressed as a percent of the maximum demand current;

(52) **'Total Harmonic Distortion' or 'THD'** means the ratio of the root mean squareof the current 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 ordesired 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 changesor 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 ther.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 andother Municipalities including the areas falling under the various Urban Development Authorities, Cantonment Authorities and Industrial Estate and Townships including those specified by the Government of Meghalaya;

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 ordistortion 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), frequency deviations, voltage unbalance, voltage fluctuations, flicker, supply interruptions, transient overvoltage or surges, 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 customers.

(5)Any failure by the Distribution Licensee or Designated Customer to achieve and maintain the power quality parameters specified in these Regulations shall render the Distribution Licensee or Designated Customer liable to payment of compensation under the EA 2003 to an affected entity.

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 all Designated Customer(s) of electricity connected at or below 33kV voltage level.

(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 Customers in distribution system. 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

The characteristic of powerquality ofelectrical supplyconsideredinthese Regulations to be controlled by designated customers is:

vii. Current harmonics

(3) These regulations unless reviewed earlier, shall remain in force from the date of notification in official gazette.

(4) 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 locations to maintain power quality in their supply area.

(3) Distribution licensee to identify the designated customers which are major power quality polluters and inject harmonics into the distribution system beyond the limits specified in these Regulations.

(4) The designated customers shall be responsible to control the harmonic injection into the distribution system within the limits specified in these Regulations.

7. Redressal of Consumer Complaints with regard to Power Quality: Theconsumer 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 2 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 10 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) Where, the designated customer is required to demonstrate that he meets the requirement of Power Quality standards, a reasonable period may be given to the designated customer on case to case basis.

(4) 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 Grievance Redressal Forum and Ombudsman.

(5) The cost of the verification shall be borne by the distribution licensee.

CHAPTER – 3

STANDARDS OF POWER QUALITY

8. Supply Voltage Variations

(1) The supply voltage variations in LV and MV 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	*Un ± 10 %*
	100% of time	*Un + 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	*Un ± 10 %*
	100% of time	*Un ± 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 %

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_t)

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 P_{st}-values over a 2 hour time interval, according to the following expression:

$$P_{lt} = \sqrt[3]{\sum_{i=1}^{12} \frac{P_{st}^3}{12}}$$

The permissible limits of short-term voltage flicker and long-term voltage flicker severity for distribution licensee shall be 1.0 and 0.8 at all supply terminals 100% of the time respectively.

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:

i. Number of events per year

ii. Event duration (t)

iii. Residual Voltage (u)

iv. Declared voltage (Uc)

Table 4: Supply Voltage Dip Limits for LV and MV Networks in Terms of Number of Events per Year.

Residual Voltage (%)	**Duration t (ms)**				
	10 ≤ t ≤ 200	**200 < t ≤ 500**	**500 < t ≤ 1000**	**1000 < t ≤ 5000**	**5000 < t ≤ 60000**
90 > u ≥ 80	30	40	10	5	5
80 > u ≥ 70	30	40	5	5	5
70 > u ≥ 40	10	40	5	5	5
40 > u ≥ 5	5	20	5	5	5

Provided 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;
The voltage dips shall be measured in all phases of supply.

12. Voltage Swells

(1) The Supply voltage swell shall comply with Table given below and are specified with reference to:

i. Number of events per year

ii. Event duration (t)

iii. Swell Voltage (u)

iv. Declared voltage (Uc)

Table 5: Supply Voltage swell Limits for LV and MV Networks in Terms of Number of Events per Year

Swell Voltage u (%)	**Duration t (ms)**		
	10 ≤ t ≤ 500	**500 < t ≤ 5000**	**5000 < t ≤ 60000**
u ≥ 120	--	--	--
120 > u ≥ 110	--	--	--

Values may be as per relevant IEC/IEEE Standard

Provided that:

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. Voltage Harmonics

(1) 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:-

$$THD_V = \sqrt{\sum_{h=2}^{N} V_h^2}$$

Where,

V_h represents the percent rms value of the hth harmonic voltage component, and N represents the highest harmonic order considered in the calculation.]

The distribution licensee shall control the value of THD_V measured at Point of Common Coupling (PCC) for LV and MV network to less than or equal to 8% and 5% respectively for 100% of time.

(2) The distribution licensee shall also control the mean rms values of each individual harmonic voltage measured over 10 minutes period up to the 25th harmonic order component to the values as given in table below:

Table 6: Values of Individual Harmonic Voltages of the Supply Voltage in Percent of the Fundamental Voltage

Odd Harmonics (%)						**Even Harmonics (%)**		
Not Multiple of 3			**Multiple of 3**					
harmonic	**LV**	**MV**	**harmonic**	**LV**	**MV**	**harmonic**	**LV**	**MV**
5	6	6	3	5	5	2	2	1.9
7	5	5	9	1.5	1.5	4	1	1
11	3.5	3.5	15	0.5	0.5	6 to 24	0.5	0.5
13	3	3	21	0.5	0.5			
17	2	2						
19	1.5	1.5						
23	1.5	1.5						
25	1.5	1.5						

(3) For statistical evaluation, voltage 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 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 at PCC in normal operating condition.

Provided that:

The limits of each individual voltage harmonics by the distribution licensee in its electricity system, point of harmonic measurement i.e. Point of Common Coupling (PCC), method of harmonic measurement and other matters shall be in accordance with per applicable notified IS and in absence of IS, the IEEE 519-2014 namely 'IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems', as modified from time to time.

14. Current Harmonics

(1) The designated customers shall limit the value of harmonic currents measured at Point of Common Coupling (PCC) measured over 10 minutes period to the values as given in table below:

Table 7: Values of Current distortion limits (TDD)

Maximum harmonic current distortion in percent of I_L						
Individual harmonic order (odd harmonics)[a, b]						
I_{SC}/I_L	3 ≤ h <11	11≤ h < 17	17 ≤ h < 23	23 ≤ h < 35	35 ≤ h ≤ 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

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

[a] Even harmonics are limited to 25% of the odd harmonic limits above;

[b] Current 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);

(2) 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 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 of TDD are measured at PCC in normal operating condition.

Provided that:

The weekly 95th percentile short time 10 min harmonic current values should be less than the value given in above Table-7. However, the weekly 99th percentile short time 10 min harmonic current values should be less than 1.5 times the value given in above Table-7.

The limits of current harmonics injected by the designated customer, point of harmonic measurement i.e. Point of Common Coupling (PCC), method of harmonic measurement and other matters shall be in accordance with per applicable notified IS and in absence of IS, the IEEE 519-2014 namely 'IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems', as modified from time to time.

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.

15. 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)

(3) Table 8: Short Voltage Interruptions Limits (number of events per year) for LV and MV Networks.

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

Provided 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;

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

16. 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 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;

Bi = 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 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 9: Limits for Reliability indices

Reliability Indices	Limits *
SAIDI	600 Minutes per customer
SAIFI	15 interruptions per customer

*Limits may be decided based on area on supply and local conditions by SERC.

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

17. Monitoring of Power Quality

(1) PQ measurement shall be implemented in phased manner and during first phase, PQ meters shall be installed at selective representative locations based on voltage level, type of consumers and significance of the power quality in such a way that such measurements should adequately represent the Power Quality and Reliability in the area of supply.

(2) The distribution licensee for the purpose of requirements for the quality of electricity supplied shall identify the locations of 33kV/11kV feeders, Distribution Transformers (DTRs) and designated customers 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 and DTRs should be identified for PQ monitoring based on type of load connected.

(3) The distribution licensee shall enforce the continuous monitoring of power quality standards at the inter-connection point of identified locations at or below 33kV voltage level for development of profile of power quality measurement in the area of supply;

(4) In the first phase, the distribution licensee shall install Power Quality meters for 50% of total 33kV/11kV feeders, 25% of total DTRs and at all designated customers supply terminals or at point of common coupling (PCC). In the second phase, Distribution Licensee shall cover 100% of 33kV/11kV feeders and at least 60% DTRs. In the third phase 100% DTRs shall be covered.

(5) 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 for all new installations/connections of identified locations. For existing installations/connections at identified locations where CTs/PTs are of lower accuracy class than mandated by IEC 61000-4-30 Class-A meters, the meters complying with the IEC 61000-4-30 Class-B may be installed. These meters should be capable of detecting direction of Harmonics (whether it is upstream or downstream) for all new installations at identified locations.

(6) In the event when the distribution licensee receives a customer complaint concerning Power Quality, the distribution licensee shall deploy power quality meter for a particular period for the purpose of verification. 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).

(7) 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.

(8) The distribution licensee may opt to integrate the smart grid meters compatible for measurement of the PQ parameters for economic and operational optimization.

18. Compliance of the Power Quality and Reliability Standards

(1) The distribution licensee shall submit the monthly and 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) It shall be the prime responsibility of the distribution licensee to comply with these Regulations and submit the compliance report every 6 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.

(3) 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.

(4) The Commission from time to time may seek reports on PQ improvements from distribution licensee.

(5) 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.

(6) 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

INCENTIVE / DIS-INCENTIVE MECHANISM FOR POWER QUALITY

19. Incentive/dis-incentive 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. Therefore, there shall not be any incentive/dis-incentive for the stakeholders during the first year after notification or as may be specified by SERCs.

(2) The expenses incurred towards implementation and monitoring of power quality parameters by the distribution licensee shall be considered in the ARR.

(3) From the second year after notification of PQ Regulations, an incentive/dis-incentive mechanism shall be implemented for distribution licensees and for designated customers. The distribution licensees or designated customers shall be liable to pay compensation.

Provided that 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 concerned Consumer Grievance Redressal Forum.

Provided further 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 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) The designated customers shall be liable to pay compensation for injecting current harmonics in to the supply system beyond the specified limits as given in Table below. In case the designated customer does not take measures to reduce the level of current harmonics (which is measured in terms of total demand distortion), he shall be made liable to pay higher

compensation progressively on each continued violation as decided by the Commission separately. When there is no improvement in power quality even after 6 months, such consumers shall be served notice of dis-connection from the supply network and shall be disconnected after approval of the Commission.

(6) Level of compensation payable for failure to meet power quality standards are given in table below:

Table 10: Level of compensation

PQ Parameter	Standard	Compensation Payable	Compensation Payable by
Voltage Variation	As per Table-1, 2 and 3	Rs.100/- per week or part thereof for which voltage	Distribution Licensee to each consumer connected on the feeder/ designated DTR. These compensations shall be cumulative for each violation.
		variation was beyond the specified limits	
Voltage unbalance		Rs.100/- per week or part thereof for which voltage unbalance was beyond the specified limits	
Voltage dips or swells	Number of events per year as per Table- 4 and 5	Rs.50/- per event for which voltage dips or swell was beyond the specified limits	
Voltage Harmonics	for LV for MV and as per Table - 6	Rs.100/- per week or part thereof for which voltage harmonics was beyond the specified limits	
Current Harmonics	As per Table-7	Compensation shall be 50 paisa per unit for the duration for which current harmonics was beyond the specified limits.	Designated Customer to distribution licensee
Short Voltage Interruptions	Number of events per year as per Table- 8	Rs.50/- per instance for which voltage dips or swell was beyond the	Distribution Licensee to each consumer

		specified limits	connected on the feeder/ designated DTR. These compensations shall be cumulative for each violation
Long Supply Voltage Interruptions	SAIDI in Minutes per Customer as per Table- 9	5 paisa/min/kW of contract demand for which SAIDI was beyond the specified limits	
Long Supply Voltage Interruptions	SAIFI in interruption per customer as per Table- 9	Rs.50/- per interruption for which SAIFI was beyond the specified limits	

Provided that such compensation as given in above Table-10 shall not be claimed in ARR by distribution licensee and further the compensation received by the distribution licensee from the designated customers shall be utilized only on the measures taken to improve power quality such as installation of filters, controllers etc.;

CHAPTER – 6

MISCELLANEOUS PROVISIONS

20. Power to Relax. The Commission, for reasons to be recorded in writing, mayrelax any of the provisions of these regulations on its own motion or on an application made before it by an interested person.

21. Power to Remove Difficulty: If any difficulty arises in giving effect to theprovisions 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.

Secretary