

## 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 95<sup>th</sup> and 99<sup>th</sup> 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<sub>f</sub>)

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

Long-Term severity (P<sub>lt</sub>) and Short-Term severity (P<sub>st</sub>).

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<sub>st</sub>-values over a 2 hour time interval, according to the following expression:

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

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 <sub>lt</sub> 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 95<sup>th</sup> 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 95<sup>th</sup> 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 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:
- i. Number of events per year
  - ii. Event duration (t)
  - iii. Swell Voltage (u)
  - iv. 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 31<sup>st</sup> 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<sub>V</sub>) considering harmonic components up to the 50th order. THD<sub>V</sub> 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  $h^{\text{th}}$  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<sub>v</sub> 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) (%)
$V \leq 1.0$ kV	5.0	8.0
$1 \text{ kV} < V \leq 69$ kV	3.0	5.0
$69 \text{ kV} < V \leq 161$ kV	1.5	2.5
$161 \text{ kV} < V$	1.0	1.5 <sup>a</sup>

<sup>a</sup>High-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**

<b>Maximum harmonic current distortion in percent of <math>I_L</math></b>						
<b>Individual harmonic order (odd harmonics)<sup>a, b</sup></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;

<sup>b</sup>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) 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**

<b>Maximum harmonic current distortion in percent of <math>I_L</math></b>						
<b>Individual harmonic order (odd harmonics)<sup>a, b</sup></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;

<sup>b</sup>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) at the PCC under normal load operating conditions;

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

**Table 10**

<b>Maximum harmonic current distortion in percent of <math>I_L</math></b>						
<b>Individual harmonic order (odd harmonics) a, b</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;

<sup>a</sup>Even harmonics are limited to 25% of the odd harmonic limits above;

<sup>b</sup>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) 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 95<sup>th</sup> & 99<sup>th</sup> 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 95<sup>th</sup> 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 99<sup>th</sup> 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 31<sup>st</sup> March, 2024. With effect from 1<sup>st</sup> 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 1<sup>st</sup> 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