

RNI No. KARBIL/2001/47147



ಕರ್ನಾಟಕ ರಾಜ್ಯಪತ್ರ

ಅಧಿಕೃತವಾಗಿ ಪ್ರಕಟಿಸಲಾದುದು
ವಿಶೇಷ ರಾಜ್ಯ ಪತ್ರಿಕೆ

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| ಭಾಗ- IVA Part-IVA | ಬೆಂಗಳೂರು, ಮಧವಾರ, ಫೆಬ್ರವರಿ ೦೩, ೨೦೧೬ (ಮಾಘ ೧೪, ಶಕ ವರ್ಷ ೧೯೩೭) Bengaluru, Wednesday, February 03, 2016 (Magha 14, Shaka Varsha 1937) | ನಂ. ೨೧೨ No. 212 |
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KARNATAKA ELECTRICITY REGULATORY COMMISSION

No. 9/2, 6th & 7th Floors, Mahalaxmi Chambers, M.G.Road, Bengaluru - 560001

NOTIFICATION

No. KERC/J/02/1/2000, Dated: 02-02-2016

KARNATAKA ELECTRICITY DISTRIBUTION CODE (KEDC), 2015

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Karnataka Electricity Distribution Code (KEDC), 2015.

Preamble:

1. The Distribution Code notified by the Commission along with the Karnataka Electricity Grid Code, 2015 (KEGC, 2015) has replaced the Distribution Code of 2005. Part VI of the Electricity Act deals with Distribution of Electricity containing provisions with respect to Distribution Licensees. Sub-Section (1) of Section 42 of the Act provides that, it shall be the duty of a Distribution Licensee to develop and maintain an efficient, coordinated and economical Distribution system in its area of supply in accordance with the provisions contained in the Act.

The Central Electricity Regulatory Commission (Indian Electricity Grid Code) Regulations, 2010, which has come into effect from 03.05.2010, has mandated upon the Distribution Licensees, various functions in the Operating Code and the Schedule and Dispatch Code covering the short-term demand estimation, formulation and implementation of State-of-the-Art demand management schemes for automatic load management like rotational load shedding, demand response (which may include lower Tariff for interruptible loads) etc., to curtail / prevent over drawal from the grid at times of low frequency etc.

Further, the CEA has notified the following Regulations:

- (i) Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006.
- (ii) Central Electricity Authority (Technical Standards for Connectivity in the Grid) Regulations, 2007.
- (iii) Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010.
- (iv) Central Electricity Authority (Grid Standards) Regulations, 2010.
- (v) Central Electricity Authority (Installation and Operation of Meters) (Amendments) Regulations, 2010.
- (vi) Central Electricity Authority (Measures Relating to Safety and Electric Supply) Regulations, 2010.

In view of the foregoing, the following Codes and Standards for the Distribution System are proposed to be revised in order to be consistent with the Regulations of CERC and CEA mentioned above.

- a. Distribution Planning Code
- b. Distribution System Planning and Security Standards
- c. Distribution operation Code
- d. Distribution System Construction, Operation and Maintenance Standards
- e. Safety Standards for Distribution System

Notification:

In exercise of powers conferred under clause (zp) of sub-Section (2) of Section 181 read with sub-Section (1) of Section 42 of the Electricity Act, 2003 (36 of 2003), and all other powers enabling it in this behalf, the Karnataka Electricity Regulatory Commission hereby makes the following Regulations.

Short title, extent and commencement:

- (1) These Regulations may be called the KERC (Karnataka Electricity Distribution Code) Regulations, 2015.
- (2) These Regulations shall come into force from the date of publication in the official Gazette of Karnataka.
- (3) These Regulations shall extend to the whole of the State of Karnataka.

SECTION-1

1.0 INTRODUCTION

1.1 GENERAL:

1.1.1 The Distribution Code consists of the following:

- a) "**Distribution Planning Code**" containing the technical and design criteria and procedures to be followed by the Licensee, users and those institutions covered under Section 13 of the Electricity Act, 2003, in the planning and development of the distribution system in his area of supply; and
- b) "**Distribution Operation Code**" containing the conditions under which the Distribution Licensee, institutions covered under section 13 of the EA, 2003 and Users shall operate their System.
- c) This code also specifies the requirements necessary to maintain the quality, security and safe operation of the system under normal and abnormal conditions.

1.1.2 The "**DISTRIBUTION CODE**" also covers all the technical and operational aspects pertaining to use of distribution system by the specific users (including Transmission Licensee) connected or seeking connection to it.

1.1.3 The Code also covers all the technical and operational aspects pertaining to planning and development of the Distribution and Retail Supply Licensee's distribution system and use of the same by specific Users connected or seeking connection to it. Further, the operation of the distribution system by the Distribution & Retail Supply Licensee, operation of their own plant by the Users (including Transmission Licensee) is also covered in this Code.

1.2 SCOPE:

1.2.1 The provisions of the Distribution Code shall be applicable to all the Distribution Licensees and to all the specific Users of the Licensee's Distribution System and those institutions covered under Section 13 of the Electricity Act, 2003.

1.2.2 Further, the Distribution Licensees and the Users connected to / seeking connection with the distribution system shall comply with the Conditions of Supply

of Electricity of the Distribution Licensees in the State of Karnataka and other applicable Regulations relating to supply of electricity.

1.3 IMPLEMENTATION AND REVIEW OF THE DISTRIBUTION CODE:

1.3.1 INTRODUCTION:

- a) A standing body called **“Distribution Code Review Panel”** shall be constituted by the Bangalore Electricity Supply Company Limited (BESCOM) comprising members as indicated in 1.3.3 (b) in line with the provisions of this Code.
- b) No change in this Distribution Code, however small or big, shall be made by the Distribution Licensees without being deliberated upon and agreed to by the Distribution Code Review Panel and thereafter approved by the KERC.

(However, in an unusual situation where normal day to day operation is not possible without revision of some clauses of Distribution Code, a provisional revision may be implemented before approval of KERC is received, but only after discussion at a special Review Panel Meeting convened on emergency basis. KERC should promptly be intimated about the provisional revision. KERC may issue directions required to revise the Distribution Code accordingly as may be specified in those directions and the Distribution Licensee shall promptly comply with any such directions).

1.3.2 OBJECTIVE:

The section defines the method of managing Distribution Code, pursuing of any changes/ modifications required and the responsibilities of the Distribution Licensees and the Users/ Consumers in this regard. This Section facilitates revisions taking into account the views of all parties in an equitable manner.

1.3.3. DISTRIBUTION CODE REVIEW PANEL:

- a) The Chairperson and the Members except the Member Secretary shall be part time members of the panel. The review panel shall generally consist of the following members having knowledge and practical experience in technical matters related to electricity supply by utilities.
- b) The Chairperson and the Secretary of the Distribution Code Review Panel shall be on rotation basis from among the members of the Distribution Licensees, but at no point of time the Chairperson and the Secretary shall belong to the same Distribution Licensee. The Secretary shall be a full time Member of the Review Panel. The Members of the Review Panel shall be as follows:

- i. One senior technical officer from each Distribution Licensee.
- ii. One Member from State Transmission Utility (STU).
- iii. One Member from SLDC.
- iv. One Member each from among Captive Power Plants, Co-Generation units, conventional and non-conventional generating units representing all such Users in Karnataka State. On completion of tenure, the Member shall be replaced by another person belonging to a different Distribution Licensee's territory.
- v. One representative from Small Scale Industries / FKCCI / Consumer Care Society.
- vi. Two independent experts in the field of electrical engineering in which one may be from a reputed academic institution.
- vii. The members of the Review Panel shall normally have tenure of two years unless he/she ceases for any reason to be member of the Review Panel. Chairperson of the Review Panel and the KERC may jointly consider the replacement of such members
- viii. The functioning of the panel shall be coordinated by the Secretary of the Review Panel.
- ix. BESCO shall publish the names of the Members of Review Panel and also inform each Distribution Licensee.
- x. The model code of functioning of Review Panel shall be finalized at first meeting of Review Panel in consultation with the KERC.

c) Functions of the Review Panel:

The functions of the Review Panel shall be:

- i. To frame its own rules and procedures for conducting its business including forming a standing secretariat and appropriate funding arrangements for the panel with the approval of the KERC.
- ii. Maintenance of the Distribution Code and its working under continuous scrutiny and review.
- iii. Consideration of all requests for review made by any User and publication of their recommendations for changes in the Distribution Code together with reasons for such changes.
- iv. Provide guidance on interpretation and implementation of the Distribution code.
- v. Examination of the problems raised by any User as well as resolution of the problems.
- vi. Ensuring that the changes/modifications proposed in the Distribution Code are consistent and compatible with Standard Technical Manual or

- Guidelines, Codes, Laws, Acts, Rules and Regulations in force at that point of time.
- vii. Constitution of a sub-Committee for detailed study of various matters pertaining to the Distribution Code and circulation of the findings and recommendations to Review Panel Members and the entities concerned.
 - viii. Making arrangements for deliberation of the issues (regarding sub-Committee findings and recommendations) in the Review Panel meetings, the time frame as provided by these sub-Committees.
 - ix. Holding of meetings as required but at least one meeting shall be held in every three months.
 - x. Holding of meetings by sub-Committees including with any User or with groups of Users to prepare proposals for review panel consideration.
 - xi. To review the causes of electrical accidents and remedial measures to avoid recurrence of such accidents
 - xii. Subsequent to any such review made, the Secretary of the Panel shall submit the following to the KERC:
 - a) A report on the outcome of any such Review Meeting
 - b) Any proposed revision or revisions, the Panel may reasonably think fit for achieving the objectives of the DISTRIBUTION CODE;
 - c) All written representations or objections from any Member of the Panel whose views were not acceptable to the Panel.

1.3.4 UNFORESEEN CIRCUMSTANCES:

In the event, any circumstance not envisaged in the provisions of the Distribution Code arises, the Distribution Licensee shall, to the extent reasonably practicable, consult promptly in good faith with all the affected Users in an effort to reach an agreement as to the further course of action. If such an agreement cannot be reached within the available time, the Distribution Licensee shall follow a prudent utility practice, keeping in view the nature of the unforeseen circumstance and the technical parameters of the affected User's system. Under such an event, the affected Users shall comply with the instructions given by the Distribution Licensee. The concerned Distribution Licensee shall however refer all such cases for consideration in the next meeting of the Panel.

1.3.5. NON-COMPLIANCE:

The Conditions of Licence require the Distribution Licensee to comply with the provisions of the Distribution Code. The Users are required to comply with the provisions of the Distribution Code, which are applicable to them. Any User or

Distribution Licensee to whom the provisions of the Distribution Code apply, and for any reason unable to comply with the same, shall promptly refer the matter to the KERC, justifying his actions. The KERC may grant exemption depending upon the merits of such matter. Non-compliance with the provisions of the Distribution Code without justifiable reasons shall constitute breach of Conditions of Licence.

SECTION 2

2.0 DEFINITIONS

- 2.1** In this Distribution Code, the following words and expressions shall, unless the subject matter or context otherwise requires or is inconsistent therewith, bear the following meanings:
- 2.1.1 **“Act”** means the Electricity Act, 2003 as amended from time to time;
- 2.1.2 **“Agreement”** means an Agreement entered into between the User and the Licensee for supply of electricity;
- 2.1.3 **“Apparatus”** means all the electrical machines, fittings, accessories, and appliances in which electrical conductors are used;
- 2.1.4 **“Area of Supply”** means the area within which a Distribution Licensee is authorized by his Licence to supply electricity;
- 2.1.5 **“Bare Conductor”** means a Conductor not covered with insulation;
- 2.1.6 **“Breakdown”** means an occurrence relating to equipment of the supply system or line, which prevents normal functioning;
- 2.1.7 **“Captive Power Plant”** means a Power Plant set up by any person to generate electricity primarily for his own use and includes a power plant set up by any Co-operative Society or Association of persons for generating electricity primarily for use of members of such Co-operative Society or Association;
- 2.1.8 **“C B I P”** means the Central Board of Irrigation and Power;
- 2.1.9 **“Circuit”** means an arrangement of conductor(s) for the purpose of carrying electrical energy and forming a system or branched system;
- 2.1.10 **“Coincidence Factor”** means the ratio of coincident peak of a group of connected loads to the sum of peaks of the individual connected loads;

- 2.1.11 **“Conductor”** means any wire, cable, bar, tube, used for conducting energy and electrically connected to the system;
- 2.1.12 **“Connected Load”** means the aggregate of manufacturer's rating of all the connected Apparatus, including portable Apparatus, in the consumer's premises. This shall be expressed in KW or KVA. If the ratings are in KVA, the same may be converted to KW by multiplying the KVA with a Power Factor of 0.85 in case of LT and 0.9 in case of HT and EHT supply. If the same or any other Apparatus is rated by the manufacturer in HP, the HP rating shall be converted into KW by multiplying it by 0.746;
- 2.1.13 **“Connection point /Interconnection”** means a point at which a User's electrical system is connected to the Licensee's Distribution System;
- 2.1.14 **“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 public under the Electricity Act, 2003, 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;
- 2.1.15 **“Contract Demand”** means the Maximum KW or KVA agreed to be supplied by the Licensee and indicated in the agreement executed between the parties;
- 2.1.16 **“Distribution Licensee”** means a Licensee authorized to operate and maintain a distribution System for supplying electricity to the Consumers in his Area of Supply;
- 2.1.17 **“Distribution System”** means the system of wires and associated facilities between the delivery points on the transmission lines or the generating station connection and the point of connection to the installations of the consumers;
- 2.1.18 **“Diversity Factor”** means the ratio of the sum of peaks of group of connected loads to the combined peak load of the group;

- 2.1.19 “**DCC**” means the Distribution Control Centre as established by the Distribution Licensee to carry out the functions specified in the Grid Code and the Distribution Code;
- 2.1.20 “**Generating company**” means any company or body corporate or association or body of individuals, whether incorporated or not, or artificial juridical person, which owns or operates or maintains a generating station;
- 2.1.21 “**GRID CODE**” means a document describing the philosophy and the responsibilities for planning, development and operation of the Karnataka State grid specified by the K.E.R.C. in accordance with sub-Section 1(h) of Section 86 of the Act;
- 2.1.22 “**Harmonic**” means the distortion of the main 50 cycle voltage OR current pure sinusoidal wave;
- 2.1.23 “**High Tension Supply (HT)**” means the nominal Voltage greater than 650 V and lesser than 66 kV;
- 2.1.24 “**Indian Standards**” means those Standards and specifications approved by the Bureau of Indian Standards;
- 2.1.25 “**Load Factor**” means the ratio of average load to peak load over a designated period;
- 2.1.26 “**Low Tension (LT) Supply**” means voltages of 650 volts and below;
- 2.1.27 “**Operational Metering**” means the monitoring of energy and power supplied to Distribution Licensee from a Transmission substation;
- 2.1.28 “**Power Factor**” means the ratio of Watts to Volt amperes or the cosine of the electrical angle between voltage and current complexors in an AC circuit (The ratio of Active Power (kW) to Apparent Power (KVA));
- 2.1.29 “**SLDC**” means the State Load Dispatch Centre established under sub-Section (1) of Section 31 of the Electricity Act, 2003;
- 2.1.30 “**STU**” means State Transmission Utility specified by the State Government under sub-Section (1) of Section 39 of the Act;

- 2.1.31 **“Total Harmonic Distortion (%THD)”** means the “Harmonic content” collectively present in a system and expressed as a percentage of the fundamental;
- 2.1.32 **“Transmission Licensee”** means a Licensee authorized to establish and operate transmission system;
- 2.1.33 **“Transmission System”** means the System consisting of extra high voltage lines/UG Cables and stations, having design/nominal voltage of 66 KV and above owned or operated by a Transmission Licensee for transmission of electrical power from the generating station / sub-Station bus bars up to the interconnection point with the distribution system. This shall not include any part of the distribution system;
- 2.1.34 **“User”** means any person having electrical interface with, or using the distribution system of the Distribution Licensee to whom this Code is applicable. Any other Distribution Licensee, institutions covered under Section 13 of the EA 2003 and generating units connected to the distribution system are also included in this term;
- 2.1.35 **“Voltage Unbalance”** means the deviation between the highest and the lowest line voltage divided by the average line voltage of the three phases;
- 2.1.36 The words or expressions occurring in this Code but not defined above shall have the same meaning as in the “GRID CODE”, or the Electricity Act, 2003, or in the Rules and Regulations framed under the said Act. In the absence thereof, the meaning commonly understood in the electricity industry shall be applicable.

SECTION-3

3.0 DISTRIBUTION PLANNING CODE

3.1 SCOPE:

- 3.1.1 The Distribution Planning Code specifies the technical and design criteria and procedure to be followed by the Distribution Licensees and institutions specified under section 13 of the Electricity Act, 2003 for a proper planning and development of the distribution system. This Code is also applicable to the Users of the distribution system for their planning and development in so far as they affect the distribution system.
- 3.1.2 The requirement of the Users may necessitate extension or reinforcement of the distribution system. In some cases, the same may even require the Distribution Licensee to seek the extension or reinforcement to the capacity of the transmission system at the Connection Point/ Interface Point. This may arise for a number of reasons mentioned below, but not limited to the same:
- a) A development by any User in his system already connected to the Distribution System;
 - b) Introduction of a new Connection Point/ Interface Point between the User's system and the Licensee's system;
 - c) To increase the capacity of the distribution system for meeting the Security Standards, removal of constraints in operation etc., and accommodate a general increase in Demand.
- 3.1.3. The development of the distribution system must be planned sufficiently in advance allowing adequate time to obtain the required statutory clearances and consents or way leaves, and for carrying out the detailed engineering, design and construction to be carried out and completed within time schedule . The suitable management techniques shall be implemented allowing for sufficient time for critical activities and to co-ordinate all the activities in an efficient manner. These shall be taken care of at the time of planning itself.

3.2 OBJECTIVES:

- 3.2.1 The following are the objectives of the Distribution Planning Code:
- a) To enable the planning, design and construction of the distribution system for a safe and economical operation with the specified degree of reliability conforming to the following standards:

- (i) Distribution System Planning and Security Standard, as per the CEA (Technical Standards for Construction of Electrical Plants and Lines) Regulations, 2010.
 - (ii) Distribution System Construction, Operation and Maintenance Standard, Safety Standard for the Distribution System as per the CEA (Measures Relating to Safety and Electric Supply) Regulations, 2010.
 - (iii) The CEA Grid Connectivity Regulations.
 - (iv) Relevant Indian Standard Specifications.
 - (v) REC Construction Standards and Manuals.
 - (vi) IEEE 519, Recommended Practice for Harmonics Control in Power Systems.
- b) To facilitate the use of the distribution system by any User connected to or seeking connection with it.
 - c) To formulate the technical conditions to be followed by the respective Distribution Licensees and Users in meeting the standards for an efficient operation of the common electrical interface.
 - d) To formulate the procedure for the exchange of the system planning data between the Distribution Licensee and the Users.
 - e) To provide the required information to the Users for connection, planning and development of their own system and make them compatible with the distribution system,
 - f) To enable the Distribution Licensee to co-operate with the STU / Transmission Licensee in furnishing the required data as detailed in the KERC (Karnataka Electricity Grid Code) Regulations, 2014.

3.3 LOAD DATA:

- 3.3.1 The Distribution Licensee shall develop load curves for the area fed by the concerned sub-Station of the STU / Transmission Licensee from the metering data available at the connection point. These data shall be compiled for the entire area of supply of the Distribution Licensee, combining the load curves of each sub-Station feeding its distribution system.
- 3.3.2 The actual energy drawn by the distribution system as recorded in the energy meters installed at connection points shall be reconciled with the actual energy sales. The distribution losses computed from these data shall be furnished to the STU and the KERC every month.

- 3.3.3 All the Users with Demands of 1.0 MW and above seeking connection with the distribution system shall furnish their load data to the Distribution Licensee as detailed in ANNEXURE- 1. The Distribution Licensee shall exercise special care to monitor the actual development of loads in respect of consumers desiring to avail loads of 1.0 MW and above at a single point including prospective Open Access Customers. The Distribution Licensee on his part shall furnish relevant system data as detailed in ANNEXURE- 2 on payment basis, if required by the User seeking connection to his distribution system. The Distribution Licensee shall update the system data regularly and at least once a year.

3.4 FORECAST METHODOLOGY :

Load forecasting shall be carried as per the KERC (load forecast) Regulations, 2009; not- inconsistent with the above Regulations the following may be adhered to:

- 3.4.1 The forecast of demand (Active and Reactive) shall be done after considering the previous five financial years as base and projecting the demand for the succeeding five years, duly considering the overall development of the various sectors in his area of supply during the period in accordance with the Government policy and economic growth etc.
- 3.4.2 The Distribution Licensee in the State, in respect of his area of supply, shall make a short-term forecast and long-term forecast with perspective for peak load and energy requirements in accordance with the procedure stipulated in the K.E.R.C. (Load Forecast) Regulations, 2009.
- 3.4.3 The projections shall take into account the assumed normal growth for non-specific loads, specific and identified loads of 1 MW and above, and the effects of Demand Side Management, if any, energy conservation measures, reduction of Distribution system losses and also the impact of Distributed Generation and standalone systems. The peak load requirements at each connection Point / Interface Point shall be estimated which will essentially ensure that the STU may determine the corrective measures to be taken to maintain the adequacy of the capacity in the transmission system upto the Connection Point / Interface Point. This will facilitate the Transmission Licensee to develop the compatible transmission system. However, if the Distribution Licensee receives power at a number of Connection Points / Interface Points in a compact area, which are interconnected in a ring, then such Distribution Licensee shall forward the overall short term demand forecast at each Connection Point / Interface Point with the variation or tolerance as mutually discussed and agreed upon with the STU.

- 3.4.4 Energy sales in each tariff class shall be projected in the forecast period over the corresponding figures relating to the base year by adopting an appropriate statistical method.
- 3.4.5 The aggregate energy and peak load requirements for the area of supply shall be estimated. The Distribution Licensee shall forward the short term demand forecast for each Connection Point / Interface Point for peak load requirement as well as aggregate and peak load demand for his area of supply on an annual basis to the STU and the K.E.R.C. along with the following details on the basis of which the forecast is made.
- a) Data,
 - b) Methodology,
 - c) Assumptions.
- 3.4.6 It shall be the responsibility of all the Distribution Licensees to fully co-operate with the STU in preparation of demand forecasts for the entire Karnataka State. The Distribution Licensees shall furnish the peak load and energy forecasts to the STU for a period of 15 years in order to enable the STU in formulating the perspective Transmission Plan for the State.
- 3.4.7 The Distribution Licensee may adopt a load forecasting methodology like **i) Trend analysis, ii) Multivariable regression/ Econometric iii) Partial end use method, iv) scenario approach etc.,** different from that adopted by CEA (in its EPS), substantiating the reasons for deviations.

3.5 PERSPECTIVE PLAN:

The Distribution Licensee shall file for Commission's approval a Perspective Plan on 1st April of the year preceding the first year of the Control period. The Perspective Plan shall be for a period of five years coinciding with the **5 year plan** period of the Country and thereafter shall be for a period of 5 years in future. The Perspective Plan for the Control Period shall inter alia contain the Sales Forecast, Power Procurement Plan and a Capital Investment Plan in accordance with the Practice Directions issued by the Commission in respect of capital investment programme and also consistent with the Regulations on Load Forecast. Further, the Distribution Licensee shall also revise the Perspective Plan every year taking into consideration of the changes occurred during the previous year and submit to the Commission as a rolling plan.

3.6 TECHNICAL AND DESIGN CRITERIA:

3.6.1 The Distribution Licensee shall plan and develop his distribution system on the basis of the technical and design criteria as follows:

- a) The load demand of all the existing Users connected to / seeking connection with the Distribution Licensee's system shall be taken into consideration. All the Apparatus and circuits shall have adequate capacity to cater to their needs of electricity in a safe, economical and reliable manner. The Distribution Licensee shall assess and forecast the load demand of each category of consumers in his area of supply on an annual basis or more frequently as required.
- b) The Distribution Licensee shall take into account during the load forecast usage of electricity by the Users and the way they use electrical energy and other alternative sources of energy in his area of supply. The load forecasting shall take into account all these along with other conservation programs and the Demand Side Management or off-peak usage programs which the Licensee may sponsor, resulting in reduction of energy and peak demand of the consumers over the years.
- c) The Distribution Licensee shall implement an appropriate load research program for the systematic collection of data describing Consumers' energy usage patterns and analysis of these data for energy and demand forecast. For this purpose, the consumers shall be divided into the following categories :
 - i. Domestic sector,
 - ii. Commercial sector,
 - iii. Agricultural sector,
 - iv. Industrial sector,
 - v. Lift Irrigation,
 - vi. Water supply and
 - vii. Street light.
- d) The pattern of energy consumed by each sector and the load demand, the period of peak demand etc., shall be made on sample surveys taking representative samples from each sector for its different seasonal requirements. A suitable questionnaire shall be prepared for these sample surveys and the data obtained shall be analyzed using suitable statistical models. Based on this, load profiles shall be drawn implementing Demand

Side Management (DSM) techniques to match the availability from time to time.

3.6.2 The load research program shall assess the following:

- a) Demand at the time of system peak, daily, monthly, seasonal or annual,
- b) Hourly demand for the day of the system peak, monthly, seasonal or annual,
- c) Category wise Diversity Factor or the Coincidence Factor and Load Factor,
- d) Total energy consumption for each category by day, month, season or year,
- e) Category wise non-coincident peak demand.
- f) The reactive power consumption at various sub-Stations catering to distribution system.

3.6.3 Based on the results of the above analysis the load forecast shall be made using appropriate modern forecasting tools wherever applicable.

3.6.4 The optimum circuit loading and the maximum number of circuits at any electrical interface between the distribution and transmission systems shall conform to the Distribution System Planning and Security Standard, Distribution System Construction, Operation and Maintenance Standard, and Safety Standard for Distribution System which forms an integral part of this Code.

3.6.5 As far as practicable, separate circuits shall be provided for the following:

- a) Urban non-industrial power supply,
- b) Urban industrial power supply,
- c) Rural Supply:
 - i. Rural agriculture supply and
 - ii. Rural non-agriculture supply

3.6.6 The loads shall be arranged as far as possible in discrete load blocks to facilitate load management during emergency operations.

3.6.7 The digital maps of distribution network shall be developed for each of the following preferably by conducting GPS survey which is easier, fast, accurate and economical:

- a) 33 kV network of complete distribution system indicating distance, type and size of conductor /size of U.G cable with single core or 3-core for lines and sub-Station particulars with Single Line Diagram (SLD).
- b) The feeder-wise 11 kV lines/cables indicating the distance, type and size of conductor /U.G cable, location and capacity of DTCs.
- c) The DTC wise L.T .line /cables with number of Consumers and connected load on each of L.T. support / L.T. feeder pillar Box.

3.6.8 Consumer indexing:

- a) The last mile of a distribution network is the pole or support in overhead system or the service pillar / feeder pillar box in underground cable distribution system. Hence, the consumer indexing has to be done with respect to the last mile of the distribution network. The integration of consumer indexing /information with DTC wise distribution network system is key to providing good consumer services and enables the utility to know how each consumer is fed normally and also on real time basis.
- b) The integration of consumer index with the distribution network will help to operate the distribution network better in the manner to simulate the network to estimate the voltage profile across the network and identify low voltage pockets without actually visiting consumer installation and measuring voltages. This will also facilitate conducting energy audit by estimating correctly the energy sales on the 11 kV Feeder / DTC and account for energy supplied to the 11 kV Feeder / DTC.

3.6.9 The load flow studies shall be conducted using Distribution Analysis Software (DAS) by properly modeling the distribution system to identify the optimal selection of conductors, capacity and location of Capacitors for reactive compensation and DTCs with appropriate capacities in order to provide quality power supply at voltages within permissible voltage regulations and to have the technical energy losses within permissible limits.

3.6.10 The following parameters of equipment and system designs shall be standardized to facilitate easy replacement and reduction of inventories of spares in stores:

- a) Capacities of 33/11kV and 11/0.4 kV Transformers,
- b) 33 kV sub-Station Layouts and 11kV Distribution Transformer Centers,
- c) Pole mounted sub-Stations,
- d) Sizes of Bus bars,
- e) Capacities and ratings of Circuit Breakers and Instrument Transformers,
- f) Earthing,
- g) Lightning Arresters,
- h) Control Panels with HT and LT Protections,
- i) Station Batteries,
- j) Fire Extinguishers.

3.6.11 The planning of the distribution system shall always keep in view the technically feasible and economically viable solutions without sacrificing the requirements of Security, Reliability and Safety Standards.

3.6.12 The Distribution Licensee shall plan the distribution system expansion and reinforcement keeping the following in view along with all other measures to accommodate and adoption of new and evolving technology:

- a) To provide reliable and quality power supply by maintaining voltage regulation within permissible limits at all consumer installations, this facilitates bringing down the energy losses within permissible limits.
- b) Maintaining optimal ratio of HT and LT line lengths to facilitate bringing down the distribution losses to less than 10%.
- c) Use of Aerial Bunched Conductors,
- d) Underground Cables,
- e) Optimizing the number of distribution transformers and their location at the electrical load centers,
- f) Balancing of the loads on each of the phases of supply in LT lines,
- g) Power factor correction.

3.6.13 ENERGY AUDIT:

The Distribution Licensee shall create responsibility centres for energy audit. Distribution sub-Division and Division in charge of Operation and Maintenance shall be made as responsibility centres and accountable for the energy input and sales in their respective areas. They shall also compute month / year wise distribution losses and prepare energy balance sheets of their respective areas. Appropriate meters shall be fixed to incoming / outgoing feeders in the area

identified for each such responsibility centre with a capability of storing half hourly load survey and Tariff metering data for 35 days by creating ring fencing.

The Division shall carry out energy audit of its total system duly compiling the data and analysis carried out in each sub-Division. The energy received at each sub-Station shall be measured at the 11 kV terminals of all the outgoing feeders installed with appropriate energy meters such that the energy supplied to each feeder is accurately measured. It shall be compared with the corresponding figures of monthly energy sales and feeder wise distribution loss shall be computed. The total losses thus computed shall be segregated for technical losses and commercial losses to facilitate initiation of the remedial measures for reduction of both technical and commercial losses separately. In case the Distribution Licensee has adopted ring main system at 11kV and there is difficulty in determining the distribution losses for each feeder, then the Distribution Licensee shall conduct energy audit for such Area of Supply.

DTC wise energy audit: the ETV meter shall be provided at secondary side of all DTCs and the monthly meter readings of all installations catered by the DTC shall be taken on the same day along with the meter reading of DTC. The month-wise DTC wise energy audit shall be conducted to facilitate reduction of commercial and technical losses. The consolidated Division wise, 11kV feeder wise, and DTC wise energy audit in which the loss level is more than the target level shall be furnished to the Commission on a monthly basis.

3.7 DISTRIBUTION SYSTEM PLANNING AND SECURITY STANDARDS

3.7.1 SCOPE:

3.7.2 This Standard specifies the guidelines for planning methodology of the distribution system.

The scope of this standard covers the distribution system comprising of Power Lines and Sub-Stations from 33 KV down to 400 / 230 Volts in respect of the following aspects.

3.8 BASIC INSULATION LEVEL (BIL) and BASIC SWITCHING INSULATION LEVEL (BSL) :

All the equipment in the Sub-Stations shall be designed to with stand the BIL values:

| SI No | Voltage | BIL(Lightning Impulse voltage in kVp (1.2/50 micro second)) | BSL (Power frequency withstand voltage in kV rms) |
|-------|---------|---|---|
| 1 | 33 kV | 170 | 90 |
| 2 | 11 kV | 75 | 28 |

The Basic Insulation Level (BIL) of the equipment to be installed in the distribution system shall be adequate to withstand the lightning surges. Lightning Arresters shall be provided for all the Transformers (power Transformers 33/11 kV and distribution Transformers 11/0.4 KV) and 33 kV and 11 kV lines. The lightning protection system to other equipment in the Sub-Station by shield wires or lightning masts shall be provided.

3.9 QUALITY OF POWER SUPPLY:

3.9.1 Voltage:

The distribution system shall conform to the design value of voltage parameter as indicated in the table below as specified in the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010.

TABLE

| Parameter | 33kV | 11 kV | 0.415 kV |
|---|------------------------|------------------------|------------------------|
| Nominal System Voltage(kV) | 33 | 11 | 0.415 |
| Highest System Voltage(kV) | 36 | 12 | 0.450 |
| System Earthing | Solidly earthed system | Solidly earthed system | Solidly earthed system |
| Lightning Impulse withstand Voltage (KV_{Peak}) | 170 | 75 | ----- |
| Power Frequency withstand Voltage(KV_{rms}) in dry condition | 90 | 28 | 3 |

3.9.2 Voltage and Current Harmonics :

The limiting values of voltage and system shall conform to the values specified in the Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 as amended from time to time.

- a) The total harmonic distortion for voltage at the connection point shall not exceed 5% with no individual harmonic higher than 3%.
- b) The total harmonic distortion for current drawn from the transmission system at connection point shall not exceed 8%.
- c) The respective User responsible for generating harmonics adversely affecting the distribution system shall be responsible for appropriate correction.

3.10 PLANNING PROCEDURE:

The distribution system shall be planned and developed in such a way that the system should be capable of meeting the requirement of all categories of Consumers including open access customers with a safe, reliable, economical and quality supply of electricity. The distribution system shall conform to the statutory requirements of

- i) The Electricity Act, 2003,
- ii) The Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007,
- iii) The Central Electricity Authority (Grid Standards) Regulations, 2010,
- iv) The Central Electricity Authority (Measures Relating to Safety and Electric Supply) Regulations, 2010.
- v) The Central Electricity Authority (Safety Requirements for Construction, Operation and Maintenance of Electrical Plants and Electric Lines) Regulations, 2011,

3.11 SERVICE AREA OF A DISTRIBUTION NETWORK:

11kV feeders taken from a Sub-Station shall to the extent possible linked to another feeder extended from another Sub-Station to enhance reliability. Disconnecting switches (Group Operating Switches) shall be installed at appropriate locations to facilitate opening of the faulty sections and enable continuity of power supply to the maximum number of consumers in the healthy section. The sizes of conductors shall be so chosen to enable supply of electricity

from either end of the feeder i.e., normally each line shall be loaded up to 60% of line capacity to facilitate changeover of the loads from either side in case of exigency.

For U.G. cable power distribution system, the Ring Main concept of connecting the feeders between the same Sub-Station bus with separate switchgear or between two Sub-Stations, it is preferable to connect between two separate Sub-Stations to improve power supply reliability. The loads on any section of the U.G. cable shall be limited to 60% of its capacity by proper designing of the size of the UG cable to facilitate changeover of loads in case of exigencies.

- 3.11.1 The Distribution Licensee shall take suitable measures, sufficiently in advance, to strengthen the network/ expansion to cater to the new/anticipated loads in order to maintain voltage regulation and energy losses within permissible limits.
- 3.11.2 Creation of digital map is the first step in computer aided distribution planning for asset mapping and efficient asset management. The Distribution Analysis Software shall be used for both distribution system strengthening and expansion which facilitate examining various alternate proposals by conducting load flow studies and techno-economical analysis and to select technically feasible and economically viable least cost alternate proposal in the following order of priority.
- a) Reactive power compensation (Providing a proper capacity of capacitor Banks at appropriate locations)
 - b) The voltage regulation limits for all loading conditions.
 - c) Reconfiguration of lines
 - d) Re-conductoring of lines.
 - e) Drawing a parallel line for load bifurcation
 - f) Providing additional Sub-Stations/ DTCs of appropriate capacity at optimal locations.

3.12 DESIGN CRITERIA FOR DISTRIBUTION LINES:

- 3.12.1 The Distribution Licensee shall design and construct distribution system for providing reliable power supply using overhead / underground / AB cable in radial / loop system as per the CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010.
- a) Depending on site conditions such as lines passing through vegetations or narrow streets, instead of conventional HT and LT lines, aerial bunched cables or UG cables shall be laid.

- b) Vertical configuration can also be adopted where constraints exist for obtaining the required horizontal clearances.
- c) Spans for the lines shall also be so chosen that, the stress on the conductors, poles and insulators does not exceed design limits.
- d) To prevent loose contact and consequent heating and failure of joints and jump connections, appropriate connectors, P.G. clamps, wedge type clamps for jump connections and jointing sleeves by using twisting wrenches for conductor joints shall be used.
- e) All the HT and LT lines with bare conductors, aerial bunched cables or UG cables shall be constructed in accordance with the relevant REC, CEA and other Standards.

The following Standards shall be adopted for planning and design purposes:

- a) The design and construction of overhead lines with bare conductors shall be generally in accordance with IS 5613 Part I, Sections 1 and 2.
- b) To prevent accidental short circuit due to galloping of conductors, vertical configuration of conductors for LT distribution lines shall preferably be adopted in open areas (rural parts) encountering with high wind velocities.
- c) The maximum length of HT and LT lines shall be limited to achieve satisfactory voltage regulation to ensure quality of power supply as specified in Para 3.8.
- d) The design and construction of overhead lines with AB cables shall be generally in accordance with REC Specifications 32 and IS 14255.
- e) The design and laying of underground cables shall be generally in accordance with IS: 1255.

3.12.2 The line supports can be of steel, wood, RCC, PCC/PSC. The RCC, PCC/PSC poles are preferred over the other two considering the cost and field condition and the factor of safety as per the CEA (Technical Standards for Construction of Electrical

Plants and Electric Lines) Regulations, 2010. The choice of the size of conductor for a line shall be made based on the following criteria:

- a) Optimal size of the conductors, type of conductor viz., Aluminum Conductor Steel Reinforced (ACSR), All Aluminum Alloy Conductors (AAAC) and number of circuits of the line shall be decided by conducting load flow studies using DAS software for various alternates and techno-economical analysis, considering the power to be transmitted. The field conditions and the factor of safety as per the CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010 are also to be considered.
- b) Length of Line;
- c) Line Voltage;
- d) Permissible voltage regulation;
- e) Mechanical strength;
- f) In coastal areas and other areas where severe corrosion is expected due to heavy rainfall and / or salinity in the atmosphere, AAAC only shall be used.

3.13 RELIABILITY ANALYSIS:

Reliability Index should be computed as indicated in the following clauses:

3.13.1 The following reliability indices shall be computed by the Distribution Licensee in respect of his area of supply every month and the reports shall be furnished to the Commission.

- a) **CAIDI:** means the '*Customer Average Interruption Duration Index*' which is the average time taken for **supply** to be restored to a **customer** when an unplanned **interruption** has occurred, calculated as the sum of the duration of each **customer interruption** (in minutes), divided by the total number of **customer interruptions** (**SAIDI** divided by **SAIFI**), unless, otherwise, stated **CAIDI** excludes **momentary interruptions**.

This index is the average duration of an interruption of supply for a Consumer, who experiences the interruptions of supply annually. This index can be

calculated for a group of consumers of an area catered by a Sub-Station or a specified area as follows:

- i. For the Transmission Licensee's transmission line failure:

Sum of the product of number of consumers affected from each feeder emanating from the Sub-Stations in the service area affected by the failure of the transmission line and the duration of interruption to each of them

$$CAIDI = \frac{\text{Sum of the product of number of consumers affected from each feeder emanating from the Sub-Stations in the service area affected by the failure of the transmission line and the duration of interruption to each of them}}{\text{Total number of consumers in the service area}}$$

- ii. For the Distribution Licensee's 11kV feeder failure:

Sum of the product of number of consumers affected from each feeder emanating from the Sub-Stations affected in the service area by the failure of power supply and the duration of interruption to each of them.

$$CAIDI = \frac{\text{Sum of the product of number of consumers affected from each feeder emanating from the Sub-Stations affected in the service area by the failure of power supply and the duration of interruption to each of them.}}{\text{Total number of consumers in the service area}}$$

- b) **System Average Interruption Frequency Index (SAIFI):** - This index is the average number of interruptions of supply that a consumer experiences annually. This is calculated in the similar manner as above except that instead of duration of interruptions, the number of interruptions shall be used.

Sum of connected load of feeder X number of sustained interruptions of that feeder in the month.

$$SAIFI = \frac{\text{Sum of connected load of feeder X number of sustained interruptions of that feeder in the month.}}{\text{Total connected load on all feeders}}$$

The following factors, which affect reliability indices, shall be considered

- Momentary incoming supply failures due to transient faults
- Momentary interruptions in 33 and 11 KV feeders due to transient faults
- Breakdown of LT feeders
- Prearranged shutdowns on lines and feeders
- Blowing out of distribution transformer fuses
- Individual fuse-off calls

3.13.2 The following data shall be collected and submitted to the Commission every month

- a) Feeder wise data on the number and duration of interruptions
- b) Number and duration of interruptions caused on account of failure of power supply at the Substation due to failure of any equipment or failure of supply to the Substation itself.
- c) Duration and number of interruptions due to defects / faults in the distribution transformer centre including failure of transformer.
- d) Duration and number of interruptions due to defects/faults in LT distribution system.
- e) Total number of consumer complaints received and attended.

3.14 STANDARDIZATION OF DESIGN OF DISTRIBUTION TRANSFORMERS:

3.14.1 The size / capacity of distribution transformers shall be as per the relevant Bureau of Indian Standards. While selecting the transformer, due regard should be given to the star ratings issued by the BEE depending upon the field conditions. As an initial step, the various technical parameters required for the design shall be incorporated in the specifications based on the experience gained regarding the performance among the various designs so far adopted. Later, standard designs of the transformers and their detailed construction drawings shall be evolved based on the performance of these transformers. These shall be adopted for future procurement. This also ensures the interchangeability of components of similar transformers manufactured by different manufacturers.

3.14.2 Quality Control & Quality Assurance

A strict quality assurance and quality system management shall be enforced to facilitate the quality of equipment and materials. The Quality Management System to be followed shall be built around a philosophy of "**prevention**" rather "**detection and cure**". The various steps involved in the Quality System Management are:

- a) Inclusion of quality requirement in the contract and selection of good quality Vendors/sub-Vendors.
- b) Approval of unambiguous Manufacturing Quality Plan (MQP).
- c) Finalization of Field Quality Plan (FQP) ensuring regular, timely and consistent inspection at various stages, viz., raw material, during in- process stage and final inspection and testing prior to dispatch.

- d) Analyze the equipment failures in association with Engineering & Operation services departments and use feedback for improvement of system.
- e) Implementation of Quality Systems & Procedures as per ISO – 9001 for system of Vendor and sub-Vendor Approvals.
- f) The list of approved sub-Vendors are to be maintained for all the equipment, materials supply and erection works irrespective of the fact whether the Technical Qualifying Requirements are specified in the contract or not. The contractors can choose any sub-Vendor from the list of a large number of sub-Vendors, with a full transparency. The list is to be continuously revised based on the feedback obtained from the inspection reports, surveillance audits and failure reports, etc.

3.14.3 Manufacturing Quality Plan

- a) A standard format is to be developed for the approval of Manufacturing Quality Plan (MQP) which includes the quality requirements at the raw material stage, in-process testing and final inspection and testing requirements as per technical specifications of the contract and good engineering practices of the industry.
- b) This document has to be self-sufficient and it should include sample size, acceptance norms, place of testing, requirements of test reports and hold point beyond which the work can progress only after clearance from the utility by standardizing the various testing requirements and procedures. It is to be ensured that it is not biased towards any particular manufacturer. These MQP(s) may be approved for a period of three years instead of approval on contract-to-contract basis.
- c) A good Quality Assurance Plan (QAP) shall be aimed at the following:
 - i. Good quality of raw materials;
 - ii. Quality control during manufacturing and routine tests;
 - iii. Acceptance tests at the time of taking delivery;
 - iv. Inspection and tests on transformers received at stores on random sampling;
 - v. Test on one transformer in a lot selected at random. The transformer should be completely dismantled. The quality of core, coil, insulation etc., physically inspected and samples of insulation and other components etc., used shall be tested and the whole lot rejected, if the sample transformer does not comply with any of the provisions of specifications.

3.15 STANDARDIZATION OF SUB-STATION LAYOUTS:

The Distribution Licensee shall develop standard layouts for the Sub-Stations of 33/11 kV and 11kV/400 volts duly complying with the requirements as specified in the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010.

3.15.1 11 KV / 433 V – 3 Phase Distribution Transformer Centers.

- a) The Distribution transformers up to 250 KVA capacity other than those meant for indoor application shall normally be pole mounted.
- b) The layout of distribution transformer centres shall generally conform to the relevant REC Construction Standards.
- c) The distribution transformers shall be located close to the electrical load centre of the load fed by it.
- d) The distribution transformers above 250 KVA capacity shall be plinth mounted.
- e) MCCBs of suitable rating shall be provided on the secondary side of the transformers above 100 KVA. Fuse units of suitable rating shall be provided for transformers upto and including 100 KVA. HRC fuses are to be provided wherever the short circuit levels are high.
- f) Wherever the 400 / 230 volt distribution lines pass through thickly populated residential areas and roads with heavy traffic, Earth Leakage Circuit Breakers of appropriate rating shall be provided to the secondary circuits of the distribution transformers.
- g) Suitable measures shall be taken sufficiently in advance, to augment the capacity of the feeders and installation of additional transformer centres in the event the specified voltage regulation limits are exceeded.

3.15.2 All the 33 KV, and 11 KV feeders and secondary side of DTCs shall be provided with ETV meters having a memory of 15/30 minutes load survey & billing parameters for 35 days with a provision of RS 232 Port to download data from the ETV meter.

3.16 REACTIVE POWER COMPENSATION:

3.16.1 Shunt capacitors of un-switched / switched type shall be installed at the appropriate places in the distribution system for power factor improvement (Pf-0.9), maintaining satisfactory voltage profile as specified in 3.8 and reduction of sub-transmission and distribution Losses. The optimization for the size and location of the capacitor installations shall be achieved by conducting studies using Distribution Analysis Software. Suitable precautionary measures, such as automatic switching off of capacitor banks etc., shall be adopted to avoid over voltages during light load periods.

3.17 SERVICE MAINS:

The service mains to consumers shall be laid in accordance with the CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010, and the CEA (Measures Relating to Safety and Electric Supply) Regulations, 2010.

3.18 METERING ARRANGEMENT:

- a) The metering for 230 volts single-phase supply shall be provided on a suitable board, located in such a place protected from sun and rain and shall be in a convenient position for taking readings. The meter shall be housed in a suitable meter housing box with provision to provide additional seals. For 400 volts three phase supply, the meters and associated metering equipment including connections shall be enclosed in a suitable meter housing box. The meter housing box shall be of sufficient strength and design with locking and sealing and shall have adequate provision for heat dissipation with the required electrical clearances. The design shall permit readings to be taken without access to the meter or its connections.
- b) For HT consumers, the meters, maximum demand indicators, and secondary connections, shall be housed in a separate compartment and other secondary apparatus such as instrument transformers and connections required shall be housed in a separate metering compartment, which shall be locked and sealed to prevent tampering.
- c) The HT metering cubicle shall be suitable for cable entry on both sides or at least on one side preferably on power supply incoming side. No fuses are permitted in the secondary circuits of the instrument transformers i.e., both CTs

and PTs. The metering cubicle shall be painted with suitable epoxy paint for installation in coastal areas having saline weather conditions and other areas experiencing heavy rainfall / pollution. The instrument transformers shall be of fixed ratio and shall not have any taps. The primary current rating of the current transformers shall match with the normal full load current and the saturation point of the core shall be higher than the maximum current that may occur due to simultaneous full load operation of all the connected equipment.

- d) For EHT consumers, the secondary terminals of the instrument transformers shall be locked and sealed and the secondary wires brought out in a suitable GI conduit pipe up to the metering panel. There shall be no screwed joints in the conduit pipes and the joints, if any, shall be welded. The energy meters shall be, as close to the instrument transformers as possible and in no case shall exceed ten (10) metres in length. The metering panel shall be housed in a weather proof enclosure with a lock and sealing arrangement.
- e) Provision for remote reading of meters for LT, HT and EHT installations shall be provided wherever considered necessary by the licensee.

3.19 SECURITY STANDARDS:

The distribution system shall be planned and maintained so as to fulfill the following security standards except under Force Majeure conditions beyond the reasonable control of the Distribution Licensee.

- a) The feeders, feeding important loads such as Hospitals, water supply, Crematoria, Airports, Railway Stations, and the like shall be planned to have a selective switching system, so that selective switching can be operated to transfer the load on to an alternate healthy feeder. Appropriate safety precautions shall invariably be taken in this regard. In case of failure of the feeder, these switches shall be operated immediately either manually or automatically depending on the importance of the load.
- b) The feeders connected to important industries/institutions which are very sensitive to interruption of even a short duration, shall be planned to have automatic switchover to an alternate healthy feeder in case of failure of supply.

- c) Loading in any current carrying component of the distribution system (e.g. conductors, joints, transformers, switchgear, cables and other apparatus) shall not exceed 75% of their respective thermal limit in case of radial feeding and 60% of their respective thermal limit in ring main feeding system.
- d) The rupturing capacity of the switchgear employed in the system shall have at least 25% more capacity than the short circuit level computed even considering the anticipated future development of the system.
- e) Provision shall be made to every feeder, either primary or secondary, to manually switch over to the immediately available feeder of the same voltage class available in the vicinity. Provision shall be made in the design itself for any feeder to share at least 50% of the loads of the adjacent feeder during emergencies.
- f) In case of single contingency failure of any Sub-Station equipment controlling outgoing 11KV feeders, the load interrupted shall not generally exceed 20% of the total demand on the substation.
- g) There shall be at least two numbers of transformers of similar rating in every 33/11kV Sub-Station.
- h) In every Sub-Station of capacity 10 MVA and above there shall be a provision for obtaining alternate 33 KV supply to the Sub-Station in case of a failure in the incoming supply.

3.20 SAFETY STANDARDS FOR DISTRIBUTION SYSTEM:

3.20.1 The distribution system shall conform to the following Regulations as specified by the Central Electricity Authority:

- a) The Central Electricity Authority (Measures Relating to Safety and Electric Supply) Regulations, 2010.
- b) The Central Electricity Authority (Safety Requirements for Construction, Operation and Maintenance of Electrical Plants and Electric Lines) Regulations, 2011.

SECTION 4

4.0. DISTRIBUTION OPERATION CODE

4.1 SCOPE:

a) This Code contains the procedures and practices to be followed for a safe and efficient operation of the distribution system by the Distribution Licensee and by the Users of the distribution system of their electrical plant and lines which are connected to the Distribution Licensee's distribution system. This shall also be applicable to any electrical interface with other Distribution Licensees.

b) The following aspects of operation are covered in this Section:

- i. Demand Estimation,
- ii. Outage Planning,
- iii. Contingency Planning,
- iv. Demand Management and Load Shedding,
- v. Interface with any Generating Plants
- vi. Communication
- vii. Monitoring and control of Voltage, Frequency and Power Factor,
- viii. Safety Co-ordination,
- ix. Major Incident and Accident reporting,
- x. Maintenance and Testing,
- xi. Tools and Spares,
- xii. Training.
- xiii. Interface with adjoining Distribution Licensees

4.2 ESTABLISHMENT OF DISTRIBUTION CONTROL CENTRES (DCC)

4.2.1 Each Distribution Licensee shall establish DCC in his area of supply to help in focused monitoring and to enable collection of data on the quantum of power and energy flow at the interface points and to interact with SLDC. This is essential to enable the State Load Dispatch Centre to coordinate with the ALDC directly in order to streamline the procedures for efficient operation of the distribution system.

4.3 Functions of DCC :

- a) To carry out the directions issued by the State Load Dispatch Centre in the matter of system operation and demand monitoring and control in his area of supply.
- b) For identifying blocks of load to facilitate shedding of load in rotation as may be necessary for achieving control of frequency for load generation balance. The 11kV feeders are to be grouped in such a way to avoid repeated interruptions to same set of consumers.
- c) Monitoring and accounting the drawal of energy by the Distribution Licensee in his area of supply.
- d) In order to carry out the above functions, the DCC shall have the required communication facilities with all the interface points and the State Load Dispatch Centre, Management and other Users.

4.4 DEMAND ESTIMATION

- 4.4.1 The DCC shall estimate the hourly and daily demands at each point of interconnection on a day ahead basis based on the data of previous day and the changes that are expected due to climate change and other factors and furnish the same to SLDC.

4.5 OUTAGE PLANNING:

- 4.5.1 The Distribution Licensee shall furnish its proposed outage programs to the DCC for onward transmission to the SLDC and the Transmission Licensee on a month-ahead basis.
- 4.5.2 The outage program shall indicate duration and extent of load affected. It should contain identification of lines and equipment of the Distribution System proposed to be taken out of service, date of start of outage, duration of outage, quantum of load affected.
- 4.5.3 The outage plan proposed by the Licensee shall be in coordination with the Transmission outage plan.
- 4.5.4 The above procedure shall not apply under emergency situation requiring immediate isolation of any part of the distribution system because of storm, danger to human life, danger to equipment etc., under the following circumstances:

- a) Disconnection to be effected on any User installation due to violation of Agreement. In this case the SLDC shall be informed wherever the load to the extent of 5 MW or more is affected.

4.6 CONTINGENCY PLANNING:

In case of blackout of any area of the distribution system the Licensee shall restore the loads as per the instructions of SLDC.

- 4.6.1 A contingency situation may arise in the event of a total or partial blackout in the transmission system. A contingency may also arise on a part of the distribution system due to local breakdown in the distribution system itself. It may also arise due to a breakdown in the apparatus of the Transmission Licensee at the point of interconnection.

4.6.2 Distribution System Failure:

- a) Interruptions of power supply in any part of the distribution system lasting for the period as specified in the KERC (Licensees' Standards of Performance) Regulations, 2004 and its amendments from time to time, due to breakdown in any part of the distribution system may be termed as distribution system failure.
- b) The Distribution Licensee shall evolve a restoration process for such a distribution system failure.

4.6.3 Failure of the Apparatus of the Transmission Licensee:

- i) The Distribution Licensee shall immediately contact the authorized person at the Sub-Station of the Transmission Licensee, and assess the probable period of restoration and the probable restriction of load drawal from the affected Substation.
- ii) The Distribution Licensee shall carry out the Demand Management Plan in accordance with SLDC instructions.

4.7 DEMAND MANAGEMENT AND LOAD SHEDDING:

- 4.7.1 DCC shall resort to temporary load shedding for maintaining the load generation balance as instructed by the SLDC. This may also be necessary due to loss of any circuit or equipment or any other operational contingency.
- 4.7.2 The DCC shall estimate Loads that may be shed in discrete blocks at each Interconnection Point in consultation with the Users supplied through independent circuits as required and submit the same to the SLDC. Such Users shall cooperate with the Licensee in this regard. The DCC shall work out the sequence of load shedding operations and the detailed procedure shall be furnished to the SLDC and to the person in-charge of Sub-Stations concerned where such load shedding has to be carried out. In case of automatic load shedding through under-frequency relays, the circuits and the amount of load to be interrupted with corresponding relay settings shall be intimated to the SLDC and persons in charge of the Sub-Stations of the Distribution Licensee as necessary.
- 4.7.3 If the duration of load shedding to any part of the distribution system is likely to exceed 60 minutes, the affected consumers with Contract Demand of 1 MW & above, the essential services such as Hospitals, Public Water Works and other consumers of the area etc., shall be intimated immediately through SMS.

4.8 INTERFACE WITH SMALL GENERATING UNITS INCLUDING CGPs:

Any Generating Unit which is in synchronization with the distribution system shall abide by the provisions of this Code.

4.9 METERING AND PROTECTION:

- 4.9.1 METERING: - All Interface meters, consumer meters and energy accounting and audit meters shall conform to the provisions of the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2010 as amended from time to time.
- 4.9.2 PROTECTION: - Protection system and its co-ordination shall conform to the provisions of the Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 as applicable to the distribution system and bulk consumers, as amended from time to time.

4.10 COMMUNICATION:

Reliable communication links shall be established by the Licensee for exchange of data, information and operating instructions with SLDC, Transmission Licensee, Generating Companies and Users with a demand of 1 MW and above.

4.11 VOLTAGE AND POWER FACTOR MONITORING AND CONTROL:

4.11.1 The Distribution Licensee shall take such measures as are necessary to maintain the Voltage and Power Factor at permissible limits within his area of operation.

4.11.2 The Distribution Licensee shall take measures to maintain a Power Factor of not less than 0.9 on each feeder at the Substation and for this purpose shall install capacitors of appropriate capacity at appropriate locations of HT and LT system. The switched capacitors may be installed, to be switched off during light loads to avoid over voltages.

4.11.3 Users having Loads with high harmonic content, low Power Factor and fluctuations shall install appropriate correction equipment.

4.12 SAFETY CO-ORDINATION:

4.12.1 The Distribution Licensee and the Users with the Licensee shall designate suitable persons to be responsible for safety co-ordination. These suitable persons shall be referred to as "**Safety Officers**".

4.12.2 The Distribution Licensee and the Users shall prepare safety manuals incorporating all the safety precautions to be taken for each component of the distribution system based on "the CEA Measures Relating to Safety and Electric Supply Regulations, 2010" and the CEA (Safety Requirements for construction, operation and maintenance of Electrical plants and Electric lines) Regulations, 2011. All the safety rules and precautions shall be observed when work is to be carried out on any Line or Apparatus, Switchgear or Circuits in any part of the distribution system or in any part of the User system. The safety manuals thus prepared shall be issued to all the control persons and Users for compliance.

4.12.3 The Distribution Licensee shall take all precautions and maintain the distribution system placed in public place in such a way that it should not endanger the lives and property by following proper Construction and Maintenance Standards and

“Measures Relating to Safety and Electric Supply Regulations, 2010” issued by the CEA from time to time.

- 4.12.4 The provisions of the Grid Code shall be followed at interconnection points in coordination with the Transmission Licensee.
- 4.12.5 Wherever any consumer has installed an emergency power supply system, either an electronic system with storage batteries or generators, the arrangement shall be such that the same cannot be operated without clearly isolating such system from the supply mains by using four pole isolating device (*Three Phases & neutral*). The possibility of a feedback from these devices to the distribution system from any of the conductors, including the neutral conductor shall be clearly ruled out.
- 4.12.6 The appropriate officers in charge of that area at the electrical interface shall issue written permission to his counterpart for carrying out the work on any Apparatus, Switchgear or Lines beyond the electrical interface. Such permissions shall be termed as **"Line Clear Permits" (LCP)**. The format of LCP shall be standardized by the Licensee and shall be used by all the concerned.
- 4.12.7 The Distribution Licensee shall frame checklist of operations to be carried out and the procedure for safety coordination for each electrical interface, before issue and return of LCPs. such procedure and checklists shall be issued to all the concerned by the Licensee for implementation.

4.13 MAINTENANCE AND TESTING:

- 4.13.1 The Distribution Licensee shall prepare Construction Standards and maintenance schedules for complete distribution system components/equipment Viz., 33 kV lines, 11 kV Primary distribution, secondary L.T distribution lines ,DTCs and 33/11 kV Sub-Stations to comply with provisions as required in the CEA *“Technical Standards for Construction of Electrical Plants and Electric Lines Regulations, 2007, and Measures Relating to Safety and Electric Supply Regulations, 2010”* and *“Safety Requirements for Construction, Operation and Maintenance of Electrical Plants and Electric Line Regulations, 2011”*.
- 4.13.2 In order to provide reliable power supply to all electricity consumers, the following best practices shall be adopted:

- a) Quality action plan, quality control including Type tests, tests on stage inspections (raw materials), routine and acceptance tests while procuring all materials and equipment.
- b) Construction and quality control while execution of distribution system strengthening & system expansion works (33 kV Lines and Substations, primary and secondary distribution system including DTCs).
- c) Scheduled system maintenance works and condition monitoring of equipment.

4.13.3 **Asset Maintenance:**

- a) The asset records are very important for condition monitoring of assets over the years and development of refurbishment and retirement of assets. The attributable data which leads to power supply breakdowns and un-safe to lives and property shall be collected at least once in a year by walk over survey from each and every component of the distribution system.
- b) The attributable data pertaining to line supports, conductors, safety clearances, insulators, earthing of non-conductive parts of the system, DTCs, U.G. Cables, RMUs, LT Feeder Pillar Boxes, Street light control boxes and service mains of consumer installations shall be collected during the survey and all the technical deficiencies shall be rectified by arranging shut downs to make the system more efficient and safe.

The DTC should be periodically checked and maintenance carried out every year including testing of quality of oil, checking of condition of fuses, and disconnection switches, as per the schedules published by Distribution licensee, if any. Maintenance of Switchgear, Protective Relays and isolators etc., shall be carried out as recommended by the manufacturers and the relevant code of practices issued by the Bureau of Indian Standards and CBIP. These shall be carried out at the prescribed intervals and the test results shall be recorded in the maintenance registers.

4.13.4 The Distribution Licensee shall maintain well trained maintenance personnel and all the required tools in good condition, and conduct the maintenance work to ensure distribution system reliability.

4.13.5 The Users shall maintain their Apparatus and Power Lines at all times conforming to:

- a) The Central Electricity Authority (Measures Relating to Safety and Electricity Supply) Regulations, 2010
- b) The Central Electricity Authority (Safety Requirements for Construction, Operation and Maintenance of Electrical Plants and Electric Lines) Regulations, 2011.

4.14 TOOLS AND SPARES:

- 4.14.1 The Distribution Licensee shall ensure availability of proper tools and tackles at all work places for carrying out the maintenance work. The tools and tackles shall be checked from time to time and their serviceability shall be ensured.
- 4.14.2 The Distribution Licensee shall maintain an inventory of spares required for maintenance and replacement purposes at suitable locations according to a clear policy to be laid down by the Licensee.

4.15 TRAINING:

- 4.15.1 The Distribution Licensee shall make appropriate arrangements for training of his workmen and supervisory staff, for imparting up-to-date techniques of distribution system design, construction, operation and maintenance. Distribution Licensee shall frame a suitable syllabus for this purpose.

4.16 DISTRIBUTION SYSTEM CONSTRUCTION, OPERATION AND MAINTENANCE STANDARD

GENERAL:

This standard is for the construction, operation and maintenance of the Licensee's distribution system to ensure safety, reliability and efficiency with maximum security.

4.17 CONSTRUCTION PRACTICE:

- 4.17.1 The construction of the distribution lines shall be carried out strictly as per the CEA (Technical Standards for Electrical Plants and Electric Lines) Regulations, 2010, CEA (Measures Relating to Safety and Electric Supply) Regulations, 2010 and also as per the following Indian Standards:
 - i) IS 7321 – Code of Practice for selection, handling and erection of concrete poles for overhead Power and Telecommunication Lines.

- ii) IS 5613 - Code of Practice for design, installation and maintenance of overhead power lines - Part 1 - Lines up to and including 11 KV - Section 2 - Installation and maintenance.
- iii) IS 5613 - Code of Practice for design, *installation and maintenance of overhead Power and Telecommunication lines* - Part 2, Lines above 11 KV and up to and including 220 KV - Section 2, Installation and Maintenance.
- iv) IS 1255 - Code of Practice for installation and maintenance of Power Cables (up to and including 33 KV).
- v) IS 14255 - Aerial Bunched Cables for working voltages up to and including 1100 Volts.
- vi) REC Specification no 32 - Aerial Bunched Cables for working voltage up to and including 1100 Volts.
- vii) IS-3043 Code of Practice for earthing.

4.17.2 As mentioned in item (iii) above, the installation practices for 33 KV lines shall be similar to that of 11 KV lines.

4.17.3 Best practices for the construction of the overhead distribution lines:

- a) The line supports to be properly erected by burying at least 1/5th the height of the support. The verticality of poles shall be maintained within reasonable limits of tolerance by concreting of foundation from the bottom up to 150 mm above the planting depth as per soil conditions. These shall be suitably designed for the particular soil condition and in any case shall not be less than 450mm x 450mm with a mix of ratio 1:3:6 commencing from the foot of the pole and extending up to 150 mm above the planting depth. Proper back-filling to be made and consolidated to prevent leaning of the supports around the concrete in the pit dug for erection of pole.
- b) Span lengths to be maintained within the designed values.
- c) Guys & stud poles to be provided at appropriate places. Storm guys to be provided wherever required for lengthy lines. The Guy shall be provided at 45 to 60 degrees to the ground or should not be less than 30° between pole and guy /stay wire to make them more effective. Break insulators to be provided to the guys at a minimum height of 3.0 meters vertically above ground level.
- d) The proper design tension within maximum and minimum values of each conductor to be maintained while stringing. Minimum ground clearances, vertical and horizontal clearances to the structures to be maintained as per the CEA

(Measures Relating to Safety and Electric Supply) Regulations, 2010. Suitable type jointing sleeves to be provided for joining the conductors using twisting wrenches, instead of just twisting the two conductors. Similar to transmission lines, the wedge type / P.G clamps to be provided for all jump connections in the distribution lines to prevent energy loss in loose jump connections, conductor snapping, etc. In order to prevent damage to the conductors, proper binding of conductors with pin insulators using aluminum tape is to be adopted.

- e) The earthed guarding to be provided at all the crossings of roads, for power lines and telephone lines.
- f) The main leads are to be properly taken to aerial fuse boards at the poles from overhead LT lines and the service mains to be connected to aerial fuse boards only. The overhead service mains to be taken in pipes or UG cable service mains to be taken right inside the meter board to prevent the consumer to have an access to service mains before energy meter.

4.17.4 For LT lines, the conductors may be of horizontal configuration or vertical configuration depending upon the field conditions ensuring the various clearances as specified in the CEA (Measures Relating to the Safety and Electric Supply) Regulations, 2010.

4.17.5 The conductors of 11 KV and 33 KV single circuit lines shall be arranged in delta formation generally by placing the top conductor on top of the pole on an insulator with a bracket clamp and placing the bottom conductors on insulators mounted on a suitable cross arm.

4.17.6 Suitable earth guard stirrups are to be provided on each pole of 11kV line when the line runs along the street and cradle guards are to be provided when the line runs across the street. The earth guard shall be properly grounded so that, in the event of a phase conductor coming in contact with it will enable the operation of protection device and render the line harmless.

4.17.7 Correct capacity fuses shall be provided and maintained in good condition at all distribution transformer centres as per the following table.

TABLE - 1
Tinned Copper Fuse Wire Sizes for Pole Mounted Transformers.

| Capacity of Transformer | Current Rating 11 KV side | Fuse Size SWG | Current Rating LT Side | LT side protection |
|--------------------------------|----------------------------------|----------------------|-------------------------------|-------------------------------------|
| 25 KVA | 1.31 amps | 38 | 36 amps | MCCBs with earth leakage protection |
| 63 KVA | 3.31 amps | 35 | 91 amps | |
| 100 KVA | 5.25 amps | 33 | 144 amps | |
| 250 KVA | 13.13 amps | 23 | 360 amps | MCCBs with earth leakage protection |
| 300 KVA | 15.75 amps | 23 | 433 amps | |
| 500 KVA | 26.24 amps | 20 | 722 amps | |

- 4.17.8 Sufficient quantity of spares such as fuses, insulators, conductors, connectors, joint kits, PG / wedge type clamps and circuit breakers etc., for quick replacement and restoration of supply shall be made available with all the O & M unit offices.
- 4.17.9 Earthing shall be carried out in accordance with IS 3043 Code of Practice for Earthing. The earth connection shall be checked periodically and maintained properly.
- 4.17.10 Every transformer center shall be provided with earthing for transformer neutral, Lightning Arrester, transformer body and other metal parts as per the "IS 3043 Code of Practice for Earthing". The following table specifies the minimum size of earth wires to be used for earthing of the neutral point of the Distribution transformers:

TABLE 2

| Transformer Rating. | Insulated PVC single core stranded aluminum conductor. |
|----------------------------|---|
| 50 KVA and below | 16 sq.mm. |
| 75 KVA | 25 sq.mm. |
| 100 KVA | 35 sq.mm. |
| 150 KVA | 70 sq.mm. |
| 200 KVA | 95 sq.mm. |
| 250 KVA | 150 sq.mm. |
| 300 KVA | 225 sq.mm. |
| 500 KVA | 300 sq.mm. |

- 4.17.11 The following table specifies the minimum size of earth lead to be used for equipment earthing, such as transformers, motors, generators, switchgear etc.

TABLE 3

| Rating of 400 V, 3 phase 50 Hz equipment in KVA. | Size of PVC insulated Aluminum earthing conductor. |
|--|--|
| Up to 5 | 6 sq.mm. |
| 6 to 15 | 16 sq.mm. |
| 16 to 50 | 16 sq.mm. |
| 51 to 75 | 25 sq.mm. |
| 76 to 100 | 35 sq.mm. |
| 101 to 125 | 50 sq.mm. |
| 126 to 150 | 70 sq.mm. |
| 151 to 200 | 95 sq.mm. |
| 201 and above | 185 sq.mm. |

4.17.12 The voltage gradient at the earth electrode at the transformer centre may attain sufficiently high value during heavy flow of ground currents and become dangerous to cattle and human life. To eliminate the possibility of danger, the top of the earth electrode shall be buried below earth surface and the connecting lead should be insulated. The top of the earth electrode shall be at least 300 mm below the surface of the soil as per clause 11.2 of IS 3043.

TABLE 4

| Sl. No. | Particulars | For LT Lines(Mtr) | For 11 KV Lines (Mtr) | For 33 KV Lines(Mtr) |
|---------|--|--|------------------------------------|------------------------------------|
| a) | Minimum height of any conductor of an overhead line, including service line across any street. | 5.8 | 6.1 | 6.4 |
| b) | Minimum height of any conductor of an overhead line, including service line along any street. | 5.5 | 5.8 | 6.1 |
| c) | Minimum height of any conductor of an overhead line, including service line erected elsewhere. | 4.6 | 4.6 | 5.2 |
| e) | Minimum vertical clearance of overhead conductor from buildings. | 3.7 Mtr (vertical) 1.8 (horizontal) | 4.5 (vertical) 1.8 (horizontal) | 4.5 (vertical) 2.5 (horizontal) |
| f) | Minimum horizontal clearance between the live wires and structures | 1.2 Mtr | 2.0 Mtr | 2.0 Mtr |

- 4.17.13 Earth electrodes, other than those used for earthing of the fence itself, shall not be installed in the proximity of the metal fence, to avoid the possibility of the fence becoming live and thus rendering it dangerous.
- 4.17.14 The street lighting posts with underground cables require a great deal of attention due to the fact that many times these cables are connected at lower levels to the insulated wires coming from street lights. A fuse box for the phase wire shall be fitted and properly maintained at these connections. The fuse box shall be provided with a hinged door, which shall be kept closed and locked from access to public and shall be periodically inspected and maintained. These fuse boxes shall be provided at a minimum height of 2.5 meters from ground level and to be perfectly earthed.
- 4.17.15 The live terminals of distribution transformers shall be at a height not less than 3.0 meters from ground level. Danger boards and Anti-climbing devices shall be invariably provided for all distribution transformer centers.
- 4.17.16 Suitable danger boards and anti-climbing devices shall be provided on the poles near the locations such as school premises, market places, in the vicinity of hamlets, villages, towns and cities etc.
- 4.17.17 The maximum span along any street in towns and cities shall not be more than 40 meters. In road crossings, the poles shall be installed on either side of the road and suitable guarding shall be provided. Wherever guarding cannot be provided due to practical reasons, aerial bunched cables shall be used for the road crossings.
- 4.17.18 The minimum clearances from any conductor of an overhead line from ground and buildings at different places shall be maintained as per the CEA (Measures Relating to Safety and Electric Supply) Regulations, 2010, as indicted in Table 4.
- 4.17.19 No joints shall be permitted on a bare conductors or wires passing over/adjacent to a building.
- 4.17.20 A tapping can be made only at the point of support. Only good quality PG or wedge type clamps shall be used to ensure good contact. Twisted joints shall be avoided.
- 4.17.21 Fuses along with isolators shall be provided to isolate different parts of the distribution system. Lightning arresters shall be provided for every 11 KV and 33 KV

outgoing feeder at the Sub-Station and at places where the lines terminate for connections to the equipment.

- 4.17.22 The entire pedestal mounted equipment such as distribution transformers, switchgear, and distribution boxes etc., installed in streets and accessible to public shall be protected by locking the doors and/or providing a suitable earthed fence with gate. "DANGER" Boards shall be prominently displayed on the fence and equipment.
- 4.17.23 The Distribution system elements in the public places should be placed in such a way that, they should not cause any hindrance to the public movement.
- 4.17.24 For the safety of telecommunication lines at locations where the overhead power line may cross over the same, the recommendations laid down in the Code of Practices of the Power and Telecommunication Co-ordination Committee shall be followed. The detailed drawing of the arrangement at crossings with telecommunication lines as furnished in REC Standards J4 and J5 shall be followed.
- 4.17.25 When erecting overhead power lines, the conductors of the same shall wherever possible, be arranged to cross over (not below) the existing telephone or telegraph lines. For any special cases where it would not be convenient or economical to remove the existing telephone or telegraph wires and erect them below the power wires, special guarding arrangements of suitable design shall be provided.

4.18 OPERATIONAL CRITERIA:

The operational criteria comprise of:

- 1) Load monitoring
- 2) Load balancing
- 3) Voltage monitoring and control
- 4) Data logging
- 5) Load management
- 6) Communication
- 7) Safety coordination

4.18.1 LOAD MONITORING:

Station Log Sheets and Registers for Station operations duly recording the hourly readings of the meters such as current, load, voltage etc., shall be maintained at each Sub-Station. A separate register for the daily energy meter readings for both the energy received and energy sent out shall be maintained along with the above.

4.18.2 LOAD BALANCING:

4.18.2.1 The unbalanced load on the LT side of the distribution transformers shall not exceed 10% during peak load.

4.18.2.2 The secondary currents and voltages of the distribution transformers shall be recorded at least once a month during expected peak load hours on all the phases.

- i. 35 days stored Load survey & billing data from the ETV meters provided on LT side of DTCs shall be down loaded from communication port every month and following analysis shall be conducted:
 - a) Peak load amperes of all three phases.
 - b) Highest & lowest voltages during the month.
 - c) Unbalanced currents between the 3 phases during peak.
 - d) Load Power Factor
 - e) Monthly active and reactive energy.
- ii. Neutral current and voltage between neutral & ground shall be measured during the peak load.

4.18.3 VOLTAGE MONITORING AND CONTROL:

4.18.3.1 The Voltage monitoring at each Sub-Station feeding 11 KV distribution system shall be monitored and voltages are adjusted to ensure that the voltage profile is within the specified limits as indicated in 3.8. The data logging of the same shall be carried out.

4.18.3.2 The voltage condition shall be monitored by operating OLTC of Power Transformers in 33 /11 KV Sub-Stations to correct voltage at the sending end whenever required.

- 4.18.3.3 The capacitor banks at appropriate locations on the 11kV side as well as 400 volts side shall be installed to maintain the PF at 0.9.
- 4.18.3.4 The voltage unbalance between phases is defined as: deviation between voltage of highest and lowest phases divided by the average voltage of three phases. The voltage unbalance shall not exceed 3% at 33 KV and 3.5% at 11 KV.

4.18.4 MONITORING OF HARMONICS:

Voltage and Current Harmonics

The Harmonic measurements shall be carried out periodically by the Licensee and action taken to reduce the harmonics accordingly.

- a) The total harmonic distortion for voltage at the connection point shall not exceed 5% with no individual harmonic higher than 3%.
- b) The total harmonic distortion for current drawn from the transmission system at the connection point shall not exceed 8%.

The measurement of harmonics and analysis should generally be in accordance with IEEE 519 guidelines or the regulations specified by the CEA.

4.18.5 DATA LOGGING:

4.18.5.1 All the important data such as Voltage, Current, Power Factor, KW, KVA and Transformer data such as tap position, oil/winding temperature, etc., shall be logged on hourly basis in all Sub-Stations.

4.18.5.2 The following records among others shall be maintained at each Sub- Station:

- a) Station log books
- b) Operation and maintenance manuals for the Sub-Station,
- c) Maintenance registers for the equipment and Station batteries,
- d) Interruption Register,
- e) Line Clearance Register,
- f) Equipment Register,
- g) Peak load register.

4.18.5.3 A detailed analysis of the above data shall be made periodically, to assess the performance of the equipment and overloading conditions if any, for taking necessary decisions.

4.18.6 LOAD MANAGEMENT:

4.18.6.1 In the event of total or partial blackouts of the State or regional transmission system, the Distribution Licensee shall follow procedures as laid down in Karnataka Electricity Grid Code (KEGC) for restoring normalcy.

4.18.6.2 In the event of breakdown within its own system, the distribution licensee shall restore/ maintain supply within the limits specified in the Standards of Performance by taking appropriate measures.

4.18.6.3 Under-Frequency relays shall be employed for automatic load control to ensure Grid Security as decided in consultation with the Regional Power Committee (RPC).

4.19 COMMUNICATION:

The Distribution Licensee shall establish reliable communication facilities such as Fax, E-mail, etc., at their Sub-Stations. All operating instructions, messages and data received from or sent to the concerned grid Substations and Load Dispatch Centers shall be duly recorded at the Substations.

4.20 SAFETY COORDINATION:

The Distribution Licensee and the consumers shall abide by the general safety requirements of the CEA regulations issued under Section 53 of the Electricity Act, 2003, for construction, installation, protection, operation and maintenance of electric supply lines and apparatus, and the procedures laid down in this CODE.

4.20.1 The Distribution Licensee shall develop safety manuals to meet the Safety Standards and submit such manuals to the Commission.

4.21 MAINTENANCE:

4.21.1 The Distribution Licensee, for the guidance of the Operation and Maintenance staff shall prepare suitable maintenance manuals and programs for the various

components of the distribution system. Proper records duly updating the maintenance work done as per schedule, the details of faults, malfunctions etc., encountered in the lines and equipment during the period, the remedial action taken, etc., for each component of the distribution system shall be kept.

4.21.2 The following pre-requisites shall be first ensured for the satisfactory maintenance:

- a) The ability of the system to meet the probable over-loading due to transfer of loads from the adjacent systems during emergencies.
- b) The quality of the materials used.
- c) Trained and adequately equipped maintenance staff.
- d) Schedule of maintenance for each component of the system.

4.21.3 The maintenance work shall consist of routine inspection, cleaning, testing and adjustments, if any, required and shall be different from the work carried out after a breakdown of any equipment in service, for restoring the same to the working condition, which cannot be planned in advance.

4.21.4 The maintenance schedules drawn shall cover the following:

- a. Inspection
- b. Preventive maintenance
- c. Overhauls

4.21.5 INSPECTION:

This shall include the periodical inspection in service for a check on the condition of the equipment/lines in service as a precautionary measure to prevent faults and defects that may develop during its operation so that advance action can be taken to rectify the defects in a planned manner and prevent breakdowns.

4.21.6 **PREVENTIVE MAINTENANCE:**

This shall cover the periodical work including Condition Monitoring, tests required to determine the electrical and mechanical strengths to ascertain the suitability in service and ensure proper working condition. The schedule shall be drawn on the basis of data obtained from inspection and maintenance checks, giving priority to the troubles encountered during normal operation of the line or equipment.

4.21.7 OVERHAULS:

This shall cover the preventive maintenance work to be done on the equipment based on the past experience and manufacturers' recommendations and involves major disassembly of the equipment. The schedule shall be drawn based on the normal life expectancy of the equipment or data obtained from inspection and maintenance checks.

The maintenance schedules shall be drawn for all the following components of the distribution system separately:

- i) Power transformers and distribution transformers of 500 KVA and above.
- ii) Pole mounted distribution transformers and capacitors.
- iii) 33 and 11 KV circuit breakers along with all the associated switchgear.
- iv) LT circuit breakers.
- v) Pole mounted Auto-Reclosers.
- vi) 33 and 11 KV distribution lines including G.O.S.
- vii) LT lines including switches and fuses.
- viii) Service connections.

4.23.1. Effective maintenance work shall be ensured keeping the following guidelines for the efficient working of the distribution system and for preventing accidents that may arise due to failure of any of the components.

- a) The pre-monsoon inspection of the distribution lines shall be carried out.
- b) The defects noticed during inspection shall be rectified at the time of inspection itself if they are of minor nature, whenever and wherever possible. In case of such of the defects, which cannot be rectified easily, the same has to be attended to at the earliest possible occasion duly chalking out a program in advance.
- c) If abnormal conditions such as excessive heating or arcing or prohibitively low clearances etc., are observed, the equipment or the line shall be immediately disconnected and rectification of defects carried out.
- d) Manufacturers' instructions shall always be given due consideration and implemented.
- e) A continuous record of all the test results shall be maintained.
- f) Appropriate inspection/maintenance checks/history sheets shall be maintained containing details of all inspection and maintenance work done.
- g) All the required safety precautions/safety devices shall be used while carrying out the maintenance works.
- h) The maintenance schedule shall be periodically reviewed by the Distribution Licensee in the light of previous experience and updated to include all

possible improvements required for ensuring adequate maintenance, prevention of accidents and reduction in interruptions.

4.23.2. Off-Schedule inspections:

Inspections of the following nature shall be carried out to maintain the system at the required level of reliability in operation.

a) **Special inspections:**

These shall be made immediately after severe weather conditions, such as heavy windstorms, thunderstorms and heavy rains to detect any damage or breakage of poles, insulators, conductors and/or equipment, and necessary action taken.

b) **Emergency inspections:** These shall be carried out on a line during its breakdown, to locate and identify the cause of trouble in order to restore the power supply.

c) **Follow up inspections:** Whenever one or more short time interruptions are noticed which may have taken place due to temporary faults, the inspection shall be carried out to locate and identify the cause of interruptions and suitable action shall be taken whenever and wherever necessary.

d) **Check inspections:** The designated engineer in charge of the distribution system shall make these inspections periodically as a check on the conditions of the line and equipment and the efficacy of maintenance. He shall point out such defects, which might not have been noticed by the maintenance staff in the first instance.

By Order of the Commission

Secretary
KARNATAKA ELECTRICITY REGULATORY COMMISSION

ANNEXURE- 1

LOAD DATA FOR DEMANDS OF 1 MW AND ABOVE

(Clause 3.3.3)

1. Type of Load;
(E.g. Furnace loads, Rolling Mills, traction loads, pumping loads, industrial loads etc.);
2. Maximum Demand (KVA);
3. Year(s) by which full / part load supply is required (Phasing of loads shall be furnished);
4. Location of load with a location map drawn to scale;
5. Rated voltage, frequency and number of phases at which supply is required;
6. Description of equipment;
 - (a) Motors: (State the purpose and number of installations, voltage and KW rating, method of starting, starting current and duration, type of motors, types of drives and control equipment etc.);
 - (b) Heating: (Type and KW rating);
 - (c) Furnace: (Type, Furnace Transformer capacity and voltage ratio);
 - (d) Electrolysis: (Purpose and KVA capacity);
 - (e) Lighting KW Demand;
 - (f) Any other loads with particulars;
7. Sensitivity of Demand to fluctuations in voltage and frequency of supply at the time of peak load: (Give details).
8. Phase unbalance imposed on the System:

Maximum: Average:
9. Maximum harmonic content imposed on the System:

(Furnish details of devices proposed for the suppression of harmonics).
10. Details of the loads likely to cause demand fluctuations greater than 10 MW at the point of connection including voltage dips (percentage) lasting for 5 seconds or more:

ANNEXURE-2

SYSTEM DATA

(Clause 3.3.3) only relevant data

- 1) Topological map of Karnataka State marking boundaries of area of supply of the Licensee
- 2) Distribution map of the Distribution Licensee drawn to scale of not less than 1 cm to 2.5 KM showing the existing 11 KV and 33 KV lines (with 11kV/ 415V Transformer and line data) and Sub-Stations within the area of supply of the Licensee. Lines and substations under construction or planned for the next five years shall be shown in dotted lines or in different colour.
- 3) Single line diagram of the distribution system showing line length, conductor sizes, Sub-Station capacity and capacitor sizes with locations, Auto-Reclosers etc.
- 4) Details of Metering and Relaying at 33 / 11 KV Sub-Stations.
- 5) Details of Grid Sub-Stations at the point of interconnections as follows:
 - MVA Capacity and voltage,
 - Number of transformers, capacity of each transformer, voltage ratios,
 - Power Transformer Tap change Ranges,
 - Fault level at substation bus bars,
 - Bus impedance,
 - Sub-Station layout diagram.
- 6) Drawal at interconnection points: Maximum and Minimum MW drawal from each interconnection with the Transmission System or with other Distribution Licensees during last six months.
 - Map showing details of interface metering
 - Data to be posted on the website in the available capacity of 33 KV and 11 KV lines for providing Open Access based on
 - a) Thermal Limits
 - b) Voltage Regulation