KARNATAKA ELECTRICITY REGULATORY COMMISSION

GRID CODE, DISTRIBUTION CODE,

STANDARDS FOR TRANSMISSION SYSTEM AND DISTRIBUTION SYSTEM

6th & 7th Floor, Mahalakshmi Chambers,
# 9/2, Mahatma Gandhi Road, Bangalore – 560 001,
Tel: 91-80-5320213, 214, Fax: 91-80-5320338
E mail:kerc@vsnl.com Web:www.kerc.org
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GRID CODE
SECTION-1

INTRODUCTION

1.1 Introduction:

1.1.1 The Indian Power System is a conglomeration of a number of Utilities, State Electricity Boards, (some of these at present are undergoing restructuring) Power Corporations, Power Grid Corporation of India, National Thermal Power Corporation, National Hydro Power Corporation etc. Restructuring of several State Electricity Boards is under process. Each State has its own Power Grid and the Inter State Transmission Lines interconnect most of these Power Grids. Some of these Inter State Transmission Lines are constructed and operated by Power Grid Corporation of India. Similarly the Central Sector Generation of Hydro, Thermal, and Nuclear Power Stations are constructed and operated by National Hydropower Corporation, National Thermal Power Corporation and NPC respectively. The Power Grid Corporation of India has been identified as the Central Transmission Utility. The Indian Electricity Grid Code approved by the CERC is applicable for planning and operation of all the Inter State Transmission Lines and the Central Sector Power Stations.

1.1.2 As far as Karnataka Power Grid is concerned, at present, the Karnataka Power Transmission Corporation Limited has been declared as the Transmission Utility under Section 27-B of Indian Electricity Act, 1910. The following functions are to be carried out by the State Transmission Utility:
a. Transmission of Energy through the Intra-state Transmission System of Karnataka Power Grid and bulk supply to Distribution & Retail Supply Licensees,

b. Planning and co-ordination for the State Power Grid with-
   i. Central Electricity Authority;
   ii. Central Transmission Utility;
   iii. Southern Regional Electricity Board;
   iv. State Government;
   v. Generating Companies;
   vi. Distribution & Retail Supply Licensees;

c. Supervision and control of the State Power Grid;

d. Complying with, and ensure compliance by others in the State, the directions the Central Transmission Utility may give from time to time in respect of matters affecting the integrated grid operation of Inter-State Transmission System.

1.1.3 In order to perform the above task, The Karnataka Electricity Regulatory Commission has formulated this "KARNATAKA ELECTRICITY GRID CODE". This Grid Code is applicable for the Karnataka Power Grid only and for the Inter State Transmission, Indian Electricity Grid Code shall be applicable.

1.2 Structure of the Grid Code:

This Grid Code consists of 14 Sections as follows:

1.2.1 Section-1: Introduction - Outlines the broad features of the Grid Code.

1.2.2 Section-2: Definitions - The various terms used in the Grid Code are defined.

1.2.3 Section-3: Management of Grid Code - The Grid Code is a live document and has to be periodically reviewed by a competent
panel as and when required in the light of experience gained. This section formulates the procedures for the same.

1.2.4 **Section-4: System Planning code** - Specifies the technical and design criteria and the procedures to be applied by the State Transmission Utility and other Users for planning and development of the Power System.

1.2.5 **Section-5: Connectivity Conditions** - Specifies the technical criteria and standards to be complied with by the Transmission Licensee, the Generating Company, the Distribution & Retail Supply Licensees and other Users connected or seeking connection to the Transmission System.

1.2.6 **Section-6: Operation Planning and Security** - Specifies the process by which the Transmission Licensee has to carry out the Planning of Power System Operation, including interface co-ordination with the users, fixing the parameters for Operation margin, contingency reserve, demand control etc., for a satisfactory grid operation and System Integrity.

1.2.7 **Section-7: System operation metering, protection, despatch and control code** - Specifies the procedure to be adopted for the scheduling of despatch of the Generating Units to meet the demand and drawal allocations, the management of frequency and voltages in the Extra High Voltage system, the minimum requirement of protection levels and metering specifications for the various components of the system.

1.2.8 **Section-8: Monitoring of Generation and drawal** - Formulates the procedure to be followed by the State Load Despatch Centre for monitoring the Generation Output, Active and Reactive reserve capacity required for evaluation of the performance of Power
Plants. The monitoring of scheduled drawal is important to ensure that the Transmission Licensee contributes towards improving the Regional performance, by observing Grid discipline.

1.2.9 **Section-9: Contingency Planning** - Formulates the recovery and normalization of power supply process to be followed by all the Users in the event of the failure of Karnataka Power Grid, or the Southern Grid resulting in total or partial collapse of the System causing blackouts.

1.2.10 **Section-10: Cross Boundary Safety** - Specifies the requirements for safe working practices for maintenance of equipment associated with cross boundary operations and also the procedure to be followed when the work is carried out on electrical equipment connected to another User's System.

1.2.11 **Section-11: Communication and Data acquisition** - Specifies the minimum requirements of Communication and Data Acquisition Facilities to be provided by each User at interconnection points and cross boundary circuits.

1.2.12 **Section-12: Operational event and Incident/Accident Reporting** - Specifies the details of minimum requirement for the exchange of information relating to Operations and/or Events on the total System including the Southern Grid which may have an operational effect.

1.2.13 **Section-13: Safety and Line clear Permits** - Sets out the procedure for recording of Line Clear Permits and guidelines for ensuring safety from electrical hazards to the consumers, general public and working personnel.

1.2.14 **Section-14: Data Registration** - Specifies a list of all the data required by the Transmission Licensee which is to be provided by the Users and the data required by the Users to be provided by the
Transmission Licensee at the required time specified in the various Sections of the Grid Code.

1.3 **Implementation and operation of the Grid Code:**

1.3.1 The State Transmission Utility shall be responsible for implementation of the Grid Code. All the Users shall comply with the Grid Code and assist the State Transmission Utility in this regard. The Users must provide all the required information and reasonable rights of access, service and facilities necessary for implementation of the Grid Code.

1.3.2 If any User has any difficulty in complying with any of the provisions of the Grid Code, he shall immediately, without delay, inform the same to the State Transmission Utility and shall remedy his non-compliance promptly.

1.3.3 Consistent failure in compliance with the Grid Code may lead to disconnection of the User’s plant or Apparatus.

1.3.4 The operation of the Grid Code shall be reviewed regularly by the Grid Code Review Panel in accordance with the provisions of the relevant Section of the Grid Code.

1.4 **Limitations of the Grid Code:**

1.4.1 The Grid Code contains procedures for the management of day to day technical situations in the Power Grid, taking into account a wide range of operational conditions likely to be encountered under both normal and abnormal conditions.

1.4.2 The Grid Code cannot foresee all the possible operating conditions. Users must therefore understand and accept that the Transmission Licensee, in such unforeseen circumstances, may be required to act decisively to discharge his obligations under the License. Users
shall provide such reasonable cooperation and assistance as the Transmission Licensee may require in such circumstances.

1.5 Procedures to settle disputes:

1.5.1 In the event of any dispute regarding interpretation between any User and the Transmission Licensee, the matter shall be referred to Karnataka Electricity Regulatory Commission. In the event of any conflict between the parties regarding any provision of the Grid Code, the Karnataka Electricity Regulatory Commission will proceed to settle the issue.

***

SECTION-2

DEFINITIONS
In the Grid Code the following words and expressions shall, unless the subject matter or context otherwise requires or is inconsistent therewith, bear the following meanings:

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<th>Term</th>
<th>Definition</th>
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<tr>
<td>Act</td>
<td>The Karnataka Electricity Reform Act, 1999.</td>
</tr>
<tr>
<td>Active Energy</td>
<td>The electrical energy produced, flowing or supplied by an electric circuit during a time interval, being the integral with respect to time of the instantaneous power, measured in units of watt-hours or standard multiples thereof, i.e., 1000 Wh = 1 kWh 1000 kWh = 1 MWh 1000 MWh = 1 GWh 1000 GWh = 1 TWh</td>
</tr>
<tr>
<td>Active Power</td>
<td>The product of voltage and the in-phase component of alternating current measured in units of watts and standard multiples thereof, i.e., 1000 Watts = 1 kW 1000 kW = 1 MW 1000 MW = 1 GW 1000 GW = 1 TW</td>
</tr>
<tr>
<td>Agency</td>
<td>A term used in various sections of the Grid Code to refer to utilities that utilize the Intra-Transmission System.</td>
</tr>
<tr>
<td>Apparatus</td>
<td>All equipment, in which electrical conductors are used, supported or of which they may form a part. In safety coordination this also means High Voltage electrical circuits forming part of a system on which safety precautions may be applied to allow work and/or</td>
</tr>
<tr>
<td><strong>testing to be carried out on a system.</strong></td>
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</tbody>
</table>
| **Apparent Power** | The product of voltage and alternating current measured in units of volt-amperes and standard multiples thereof, i.e.,
1000 VA = 1 kVA  
1000 kVA = 1 MVA |
<p>| <strong>Area of supply</strong> | Area designated in the licence for carrying out the licenced activity. |
| <strong>Automatic Voltage Regulator (AVR)</strong> | A continuously acting automatic excitation system to control a Generating Unit terminal voltage. |
| <strong>Auxiliaries</strong> | All the plant and machinery required for the Generating Unit's functional operation that do not form part of the Generating Unit. |
| <strong>Availability</strong> | The capability of the Generating Unit expressed in MW. &quot;Fully Available&quot; shall mean that the Generating Unit is available to its contracted capacity. In respect of the Transmission System, &quot;Availability&quot; shall mean the time in hours the Transmission System is capable of transmitting Electricity at its rated voltage from the supply point to the delivery point and expressed as a percentage of Annual Availability. |
| <strong>Backing Down</strong> | Reduction of generation on instructions from SLDC/SRLDC by a Generating Unit under abnormal conditions. |
| <strong>Back-up protection</strong> | Protection equipment or systems which are intended to operate when a system fault is not cleared in due time |</p>
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<tr>
<th>Terms</th>
<th>Definitions</th>
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<tr>
<td>Black Start</td>
<td>The procedure necessary for a recovery from a Total Shutdown or Partial Shutdown without the availability of electricity from external sources.</td>
</tr>
<tr>
<td>Black Start Capability</td>
<td>An ability in respect of a Black Start Station, for at least one of its Generating Units or CCGT Units to Start-Up from Shutdown and to energize a part of the system and be synchronized to the system upon instruction from the State Load Dispatch Centre, within two hours, without any external supply.</td>
</tr>
<tr>
<td>Black Start Stations</td>
<td>Power Stations having Black Start Capability.</td>
</tr>
<tr>
<td>Bulk supply</td>
<td>The sale of Electricity to any person for resale such as, supply given to a Retail Supply Licensee for purposes of distribution and resale in his area of supply.</td>
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<tr>
<td>Bulk Supplier</td>
<td>“Bulk Supplier” means any person who is authorized to carry out bulk power supply.</td>
</tr>
<tr>
<td>Bulk Supply Licensee</td>
<td>Any person/Company authorized by KERC for engaging in the business of bulk supply of electricity.</td>
</tr>
<tr>
<td>Captive Power Plant (CPP)</td>
<td>A Power Plant primarily operated to meet a captive demand and also connected to the Transmission/Distribution Systems. Such a plant shall hold valid consent under Section 17 of the Act and permission for sale of surplus power to the Transmission/Distribution &amp; Retail Supply Licensees.</td>
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<tr>
<td><strong>Caution Notice</strong></td>
<td>A notice conveying a warning against interference.</td>
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<tr>
<td><strong>CBIP</strong></td>
<td>Central Board of Irrigation and Power.</td>
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<tr>
<td><strong>CCGT</strong></td>
<td>Combined Cycle Gas Turbine.</td>
</tr>
<tr>
<td><strong>CEA</strong></td>
<td>Central Electricity Authority.</td>
</tr>
<tr>
<td><strong>Central</strong></td>
<td>Any Government Company notified by the Central</td>
</tr>
<tr>
<td><strong>Transmission</strong></td>
<td>Government under section 27A of the Electricity</td>
</tr>
<tr>
<td><strong>CERC</strong></td>
<td>Central Electricity Regulatory Commission.</td>
</tr>
<tr>
<td><strong>Connected</strong></td>
<td>Actual Data replacing estimated values assumed for</td>
</tr>
<tr>
<td><strong>Planning Data</strong></td>
<td>planning purposes.</td>
</tr>
<tr>
<td><strong>Connection</strong></td>
<td>The electric power lines and electrical equipment used to effect a connection of a User’s System to the Transmission System.</td>
</tr>
<tr>
<td><strong>Connection</strong></td>
<td>Those conditions mentioned in Section 5 (“Connection Conditions”) which have to be fulfilled before the Users’ System is connected to the Grid.</td>
</tr>
<tr>
<td><strong>Connection</strong></td>
<td>A Grid Supply Point or Grid Entry Point, as the case may be.</td>
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<tr>
<td><strong>Point</strong></td>
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<tr>
<td><strong>Consumer</strong></td>
<td>A person to whom electrical power is provided.</td>
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<tr>
<td><strong>Contingency</strong></td>
<td>The available standby generation over forecast demand, which is required in the period from 24 hours ahead down to real time to cover against uncertainties in Generating Plant availability and against errors in forecast.</td>
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<td><strong>Reserve</strong></td>
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<td><strong>Control Engineer</strong></td>
<td>A person identified as having responsibility for cross boundary safety under section 11 “Cross Boundary Safety” of the Grid Code.</td>
</tr>
<tr>
<td><strong>Customer Demand Control</strong></td>
<td>Reducing the supply of electricity to a Customer or disconnecting a Customer in a manner agreed for commercial purposes between a supplier and its Customer.</td>
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<tr>
<td><strong>Demand</strong></td>
<td>The demand of MW and MVA of electricity (i.e. both Active and Apparent Power), unless otherwise stated.</td>
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</table>
| **Demand Control** | Any of the following methods of achieving a Load reduction:  
(a) Customer Load Management initiated by Users.  
(b) Customer voltage reduction initiated by Users (other than following an instruction from Load Despatch Centre).  
(c) Customer Load reduction by Disconnection initiated by Users (other than following an instruction from Load Despatch Centre).  
(d) Customer Load reduction instructed by the Load Despatch Centre.  
(e) Automatic low Frequency Load Disconnection.  
(f) Emergency manual Load Disconnection. |
| **Designed Minimum Operating Level** | The output (in whole MW) below which a Despatch Unit is generally not allowed to operate according to prudent operating practice. |
| **Despatch** | Operational control of an integrated electricity system involving operations such as:  
- Assignment of levels of output to specific Generating Plant or load control devices to effect the most reliable and economical supply as the
loads vary,
- The control of the operation of extra high voltage lines, associated substations and equipments,
- The scheduling of various types of transactions with the electric utilities over the interconnecting Transmission Lines.

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<th>Definition</th>
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<td>De-Synchronize</td>
<td>The act of taking a Generating Unit off a system to which it has been Synchronized.</td>
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<tr>
<td>Disconnection</td>
<td>The physical separation of Users or Customers from the System.</td>
</tr>
<tr>
<td>Discrimination</td>
<td>The quality where a relay or protective system is enabled to pick out and cause to be disconnected only the faulty Apparatus.</td>
</tr>
<tr>
<td>Distribution</td>
<td>“Distribution System” means any system consisting mainly of cables, service lines and overhead lines, electrical plant and meters having design voltage of 33 KV and below. The distribution system shall not include any part of a transmission system except the terminal equipment used for the supply of electricity to extra high voltage (66 KV and above) Consumers.</td>
</tr>
<tr>
<td>Distribution &amp;</td>
<td>Any person/company authorized by KERC for engaging in the business of Distribution &amp; Retail Supply Licensees of Electricity.</td>
</tr>
<tr>
<td>Retail Supply</td>
<td></td>
</tr>
<tr>
<td>Licensees</td>
<td></td>
</tr>
<tr>
<td>Drawal</td>
<td>The import/export of Electrical Energy from/to the grid.</td>
</tr>
<tr>
<td>Earthing</td>
<td>Connecting the conducting parts of an equipment or machinery with the general mass of earth, in such a manner ensuring at all times an immediate discharge</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
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</tr>
<tr>
<td>Earthing Device</td>
<td>A means of providing connection between a conductor and earth being of adequate strength and capability.</td>
</tr>
<tr>
<td>Emergency Instruction</td>
<td>A Despatch instruction issued by the Load Despatch Centre, to a Despatching Unit which may require an action or response which is outside Generation Scheduling and Despatch Parameters, Generation and other relevant Data or Notice to Synchronize.</td>
</tr>
<tr>
<td>Excitation System</td>
<td>The equipment providing the field current of a machine, including all regulating and control elements, as well as field discharge or suppression equipment and protective devices.</td>
</tr>
<tr>
<td>Exciter</td>
<td>The Source of electrical power providing the field current of a Synchronous Machine.</td>
</tr>
<tr>
<td>External interconnection</td>
<td>Apparatus for the transmission of electricity to or from the Karnataka Grid into or out of the Southern Grid.</td>
</tr>
<tr>
<td>Fault Current Interruption Time</td>
<td>The time interval from fault inception until the end of break time of the circuit breaker.</td>
</tr>
<tr>
<td>Frequency</td>
<td>The number of alternating current cycles per second (expressed in Hertz) at which the system is operating.</td>
</tr>
<tr>
<td>Generating Company</td>
<td>“Generating Company&quot; means a Company registered under Company’s Act, 1956 (1 of 1956) and which has among its objectives the establishment, operation and maintenance of generating stations.</td>
</tr>
<tr>
<td>Generating</td>
<td>A Power Station connected to the Transmission System.</td>
</tr>
<tr>
<td><strong>Plant</strong></td>
<td>and available for Scheduling by the Load Despatch Centre.</td>
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<tr>
<td><strong>Generating Unit</strong></td>
<td>The combination of an Electric Power Generator and its Prime mover and all of its associated equipment, which together constitutes a single generating machine</td>
</tr>
<tr>
<td><strong>Generation Schedule</strong></td>
<td>The despatch schedule of a Generating Station.</td>
</tr>
<tr>
<td><strong>Generator capability curve</strong></td>
<td>A diagram, which shows the MW and MVAR capability limits within which a Generating Unit will be expected to operate under steady state conditions.</td>
</tr>
<tr>
<td><strong>Governor Deadband</strong></td>
<td>The total magnitude of the change in steady state speed [expressed as a range of Hz (±xHz) where “x” is a numerical value] within which there is no resultant change in the position of the governing valves of the speed/load Governing System.</td>
</tr>
<tr>
<td><strong>Grid Code</strong></td>
<td>“Karnataka Electricity Grid Code” - a document describing the procedures and the responsibilities for planning and operation of Karnataka Power Grid.</td>
</tr>
<tr>
<td><strong>Grid Code Review Panel or &quot;Panel&quot;</strong></td>
<td>The Panel with the functions set out in the Grid Code.</td>
</tr>
<tr>
<td><strong>Grid Entry Point</strong></td>
<td>A point at which a Power Station is connected to the Transmission System of Karnataka Power Grid.</td>
</tr>
<tr>
<td><strong>High Voltage or HV</strong></td>
<td>Voltages ranging from 650 volts to 33KV.</td>
</tr>
<tr>
<td><strong>IE Rules</strong></td>
<td>Indian Electricity Rules 1956.</td>
</tr>
<tr>
<td><strong>IEC</strong></td>
<td>International Electro-Technical Commission</td>
</tr>
<tr>
<td>Terms</td>
<td>Definitions</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>IEC Standard</td>
<td>A standard approved by the International Electrotechnical Commission.</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institution of Electrical and Electronic Engineers, Inc., USA.</td>
</tr>
<tr>
<td>IEGC</td>
<td>Indian Electricity Grid Code - A formal document describing the philosophy and responsibilities for planning and operation of Indian Power System approved and mandated by CERC.</td>
</tr>
<tr>
<td>Independent Power Producer (IPP)</td>
<td>A person or Agency involved in the exclusive business of Power Generation excluding Central Generating Stations and State owned Generating Companies.</td>
</tr>
<tr>
<td>Indian Standards (&quot;IS&quot;)</td>
<td>Those Standards and specifications approved by the Bureau of Indian Standards.</td>
</tr>
<tr>
<td>Interconnection Transformer (ICT)</td>
<td>Transformer connecting EHV lines of different voltage systems.</td>
</tr>
<tr>
<td>Interface Agreement</td>
<td>An agreement between a User and STU containing provisions for dealing with the consequences of user owning or operating plant or apparatus which is sited on another user’s land and/or for sharing the facilities and/or the provisions of services at/or near a connection site.</td>
</tr>
<tr>
<td>Intertrip Apparatus</td>
<td>Apparatus that performs intertripping.</td>
</tr>
<tr>
<td>Intertripping</td>
<td>(a) The tripping of circuit-breaker(s) by commands initiated from Protection at a remote location independent of the state of local Protection; or (b) Operational intertripping.</td>
</tr>
<tr>
<td><strong>Isolating Device</strong></td>
<td>A device for achieving Isolation.</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td><strong>Isolation</strong></td>
<td>The disconnection of HV Apparatus from the remainder of the System in which that HV Apparatus is situated.</td>
</tr>
<tr>
<td><strong>KERC</strong></td>
<td>Karnataka Electricity Regulatory Commission.</td>
</tr>
<tr>
<td><strong>KPCL</strong></td>
<td>Karnataka Power Corporation Limited.</td>
</tr>
<tr>
<td><strong>KPTCL</strong></td>
<td>Karnataka Power Transmission Corporation Limited.</td>
</tr>
<tr>
<td><strong>KPTCL Site</strong></td>
<td>Means a site owned (or occupied pursuant to a lease, licence or other agreement) by KPTCL in which there is a Connection Point. For the avoidance of doubt, the portion of User's site occupied by KPTCL as aforesaid, is a KPTCL Site.</td>
</tr>
<tr>
<td><strong>Lean Period</strong></td>
<td>That period in a day when the electrical power demand is lowest.</td>
</tr>
<tr>
<td><strong>Licence</strong></td>
<td>Any license granted by KERC.</td>
</tr>
<tr>
<td><strong>Licence Standards</strong></td>
<td>Those standards set out or referred to in the Transmission/Bulk Supply/Distribution &amp; Retail Supply Licences.</td>
</tr>
<tr>
<td><strong>Load</strong></td>
<td>The Active, Reactive or Apparent Power as the context requires, generated, transmitted or distributed.</td>
</tr>
<tr>
<td><strong>Load Factor</strong></td>
<td>Load Factor is the ratio of the average power to the maximum demand. The load factor depends on the interval of time of the maximum demand and the period over which the average is taken.</td>
</tr>
</tbody>
</table>

\[
\text{Load Factor} = \frac{\text{Units consumed in a given period}}{\text{Maximum Demand} \times \text{No. of hours in the period}}
\]
<table>
<thead>
<tr>
<th><strong>Loaded</strong></th>
<th>Supplying electrical power to the System.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local Safety Instructions</strong></td>
<td>The safety manuals and instructions framed and issued by the User and KPTCL, setting down the methods and procedures to be adopted and precautions to be taken to ensure complete safety to the personnel carrying out the operation, maintenance and testing of the plant and apparatus.</td>
</tr>
<tr>
<td><strong>Low Voltage or LV</strong></td>
<td>Voltage not exceeding 650 volts.</td>
</tr>
<tr>
<td><strong>Main Protection</strong></td>
<td>Protection equipment or system expected to have priority in initiating either a fault clearance or an action to terminate an abnormal condition in a power system.</td>
</tr>
<tr>
<td><strong>Multiple Point Connection</strong></td>
<td>Two or more points of Connection interconnected to each other through the User's System.</td>
</tr>
<tr>
<td><strong>Notice to Synchronize</strong></td>
<td>The amount of time (expressed in minutes) that is declared by a Generating Company in relation to a Generator to enable it to be synchronized following the receipt of an instruction to synchronize.</td>
</tr>
<tr>
<td><strong>NPC</strong></td>
<td>Nuclear Power Corporation.</td>
</tr>
<tr>
<td><strong>Operating Margin</strong></td>
<td>Contingency Reserve plus Operating Reserve.</td>
</tr>
<tr>
<td><strong>Operating Reserve</strong></td>
<td>The additional output from a Generating Plant, which must be realizable in real-time operation to correct any System Frequency fall to an acceptable level, in the event of a loss of generation, or loss of import from an External Interconnection, or mismatch between generation and Demand.</td>
</tr>
<tr>
<td>Operation</td>
<td>A scheduled or planned action relating to the operation of a System.</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td>Operational Data</td>
<td>Data required under the Operating Codes and/or Scheduling and Despatch Codes.</td>
</tr>
<tr>
<td>Operational Planning</td>
<td>Planning carried out to achieve, as far as possible, the standards of security set out in the Transmission Planning and Security Standard through various time scales, the matching of generation output with forecast Demand together with a reserve of generation to provide a margin, taking into account outages of the following to which the Power Stations and/or Customers are connected: (1) Certain Generating Units, (2) Parts of the Transmission System, and (3) Parts of User Systems.</td>
</tr>
<tr>
<td>Operational Procedures</td>
<td>Management instructions and procedures, both for the Safety Rules and for the local and remote operation of Plant and Apparatus, issued in connection with the actual operation of Plant and/or Apparatus at or from a Connecting Site.</td>
</tr>
<tr>
<td>Out of Synchronism</td>
<td>The condition where a System or Generating Unit cannot meet the requirements to enable it to be Synchronized.</td>
</tr>
<tr>
<td>Outage</td>
<td>A total or partial regulation in availability due to repair and maintenance of the Transmission or Distribution or Generation facility or defect in Auxiliary System.</td>
</tr>
<tr>
<td>Part Load</td>
<td>The condition of a Power Plant which is Loaded but is</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Partial Shutdown</td>
<td>A shutdown of a part of the system resulting in failure of power supply, either from external interconnections or from the healthy part of the system.</td>
</tr>
<tr>
<td>Peak Period</td>
<td>That period in a day when the electrical power demand is highest.</td>
</tr>
<tr>
<td>Person</td>
<td>Any individual connected with the generation, transmission, distribution and utilization of electrical power.</td>
</tr>
<tr>
<td>PGCIL</td>
<td>Power Grid Corporation of India Limited.</td>
</tr>
<tr>
<td>Planned Outage</td>
<td>An outage of Generating Plant or part of the Transmission System, or part of a User's system coordinated by SLDC.</td>
</tr>
<tr>
<td>Point of Connection</td>
<td>An electrical point of connection between the Transmission System and the User's System.</td>
</tr>
<tr>
<td>Point of Isolation</td>
<td>The point on Apparatus at which Isolation is achieved.</td>
</tr>
<tr>
<td>Power Factor</td>
<td>The ratio of Active Power to Apparent Power.</td>
</tr>
<tr>
<td>Power Purchase Agreement</td>
<td>The agreement entered into between the Generating Company and the Transmission Licensee/Bulk Supply Licensee/Distribution &amp; Retail Supply Licensee.</td>
</tr>
<tr>
<td>Power Station</td>
<td>An installation comprising one or more Generating Units owned and/or controlled by the same Generating Company.</td>
</tr>
<tr>
<td>Protection</td>
<td>The schemes and apparatus for detecting abnormal conditions on a System and initiating fault clearance or actuating signals or indications.</td>
</tr>
<tr>
<td>Protection</td>
<td>A group of one or more Protection Relays and/or logic</td>
</tr>
<tr>
<td>Apparatus</td>
<td>elements designated to perform a specified Protection function.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Prudent Utility Practices</td>
<td>Those practices, methods, techniques and standards, as modified from time to time, that are generally accepted for use in the International Electric Utility Industry, taking into account the prevailing conditions in India. These shall be the ones commonly used in electrical utility for engineering and operations such as the design, engineering, construction, testing, operation and maintenance of equipment lawfully, safely, efficiently and economically, as applicable to the equipment of certain size, service and type. These practices, methods, standards and acts shall be adjusted to the extent necessary in order:</td>
</tr>
<tr>
<td>1. To conform to operation and maintenance guide lines recommended by the equipment manufacturers and suppliers and shall also be in accordance with the guide lines given in the relevant IS Code of Practices for such equipments wherever available,</td>
<td></td>
</tr>
<tr>
<td>2. To ensure compliance with the IE Act and Rules and other related laws,</td>
<td></td>
</tr>
<tr>
<td>3. To take into account the site location, including (without limitation) the climatic, hydrological and other environmental or general conditions thereof,</td>
<td></td>
</tr>
<tr>
<td>4. To conform to energy conservation, and</td>
<td></td>
</tr>
<tr>
<td>5. To conform to General Safety Standards.</td>
<td></td>
</tr>
<tr>
<td><strong>Rated MW</strong></td>
<td>The &quot;rating plate&quot; MW output of a Generating Unit, being that output up to which the Generating Unit is designed to operate.</td>
</tr>
<tr>
<td><strong>Reactive Power</strong></td>
<td>The product of voltage and current and the sine of the phase angle between them measured in units of volt-amperes reactive and standard multiples thereof, i.e.: 1000 VAr. = 1kVAr 1000 kVAr = 1 MVAr</td>
</tr>
<tr>
<td><strong>Regulating Margin</strong></td>
<td>The system voltage and frequency beyond which the system should not be operated.</td>
</tr>
<tr>
<td><strong>Retail Supply</strong></td>
<td>“Retail Supply” means the sale of electricity to consumers.</td>
</tr>
<tr>
<td><strong>Responsible Engineer/ Operator</strong></td>
<td>A person nominated by an User to be responsible for System control.</td>
</tr>
<tr>
<td><strong>Re-synchronization</strong></td>
<td>The bringing of parts of the System which has gone out of Synchronism with each other, back into Synchronism.</td>
</tr>
<tr>
<td><strong>Safety Co-ordinator</strong></td>
<td>A person or persons nominated by the Transmission Licensee and each User to be responsible for the co-ordination of Safety Precautions at each connection point when work (including testing) is to be carried out on a system, which necessitates the application of Safety Precautions on HV Apparatus.</td>
</tr>
<tr>
<td><strong>Safety from the System</strong></td>
<td>Those conditions which safeguard persons carrying out the work on a System from the dangers, which are inherent in the System.</td>
</tr>
<tr>
<td><strong>Safety Rules</strong></td>
<td>The rules framed by the Users and the Transmission</td>
</tr>
</tbody>
</table>

**CODES & STANDARDS: KERC**

- 25 -
<p>| <strong>Licensee to ensure safety to persons working on Plant/Apparatus.</strong> |
| <strong>Schematic Diagrams</strong> | Diagrams which are a schematic representation of the HV Apparatus and the connections to all external circuits at a Connection Site, incorporating its numbering, nomenclature and labeling. |
| <strong>Single Point Connection</strong> | A single Point of Connection, with no interconnection through the User's System to another Point of Connection. |
| <strong>SLDC</strong> | State Load Despatch Centre. |
| <strong>SREB</strong> | Southern Regional Electricity Board. |
| <strong>SRLDC</strong> | Southern Regional Load Despatch Centre. |
| <strong>Standing Instructions</strong> | An instruction issued by SLDC to a Generating Company whereby, in specified circumstances, the Generating Company should take specified action, as though a valid dispatch instruction has been issued by SLDC. |
| <strong>Start-Up</strong> | The action of bringing a Generating Unit from Shutdown to Synchronous Speed. |
| <strong>State Transmission Utility (STU)</strong> | The utility notified by the Government under Sub-Section (1) of Section 27B of Indian Electricity Act 1910, as amended in 1998, and whose functions have been outlined under Section 55 of Amendments to the Electricity Supply Act 1948 issued in 1998. |
| <strong>Station Transformer</strong> | A transformer supplying electrical power to the Auxiliaries of a Power Station, which is not directly connected to a Generating Unit terminal. |</p>
<table>
<thead>
<tr>
<th><strong>Supply</strong></th>
<th>“Supply” means the Procurement, Distribution and Provision of electricity by a supplier either for resale or directly to the Consumers.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supplier</strong></td>
<td>“Supplier” means any person who holds a licence under Section 19 of the Act or is granted an exemption under Section 20 of the Act.</td>
</tr>
<tr>
<td><strong>Supervisory Control and Data Acquisition or (SCADA)</strong></td>
<td>The communication links and data processing systems, which provide information to enable implementation of requisite supervisory and control actions.</td>
</tr>
<tr>
<td><strong>Supply Act</strong></td>
<td>Electricity Supply Act, 1948.</td>
</tr>
<tr>
<td><strong>Synchronized</strong></td>
<td>Those conditions where an incoming Generating Unit or System is connected to the busbars of another System so that the frequencies and phase relationships of that Generating Unit or System as the case may be, and the System to which it is connected are identical.</td>
</tr>
<tr>
<td><strong>Synchronous Compensation</strong></td>
<td>The operation of rotating synchronous Apparatus for the specific purpose of either generation or absorption of Reactive Power.</td>
</tr>
<tr>
<td><strong>Synchronous Speed</strong></td>
<td>That speed required by a Generating Unit to enable it to be Synchronized to a System.</td>
</tr>
<tr>
<td><strong>System</strong></td>
<td>Any User System and/or Transmission System, as the case may be.</td>
</tr>
<tr>
<td><strong>System Constraint</strong></td>
<td>A limitation on the use of a System due to lack of transmission capacity or other system conditions.</td>
</tr>
<tr>
<td><strong>System Margin</strong></td>
<td>The margin in any period between (a) Declared Availability and</td>
</tr>
<tr>
<td><strong>Total System</strong></td>
<td>The KPTCL System and all User Systems in Karnataka.</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td><strong>Transmission Licence</strong></td>
<td>The Licence granted by KERC for power transmission.</td>
</tr>
<tr>
<td><strong>Transmission Licensee</strong></td>
<td>The holder of a Transmission License issued by KERC.</td>
</tr>
<tr>
<td><strong>Transmission Services Agreement</strong></td>
<td>The agreement between the Transmission Licensee and the User in which, subject to certain conditions, the Transmission Licensee agrees to transmit/wheel electrical power over its network to the User.</td>
</tr>
<tr>
<td><strong>Under Frequency Relay</strong></td>
<td>An electrical measuring relay intended to operate when its characteristic quantity reaches the relay settings by decrease in frequency.</td>
</tr>
<tr>
<td><strong>Unit Auxiliary Transformer</strong></td>
<td>A transformer directly connected to a Generating Unit's terminals, and which supplies power to Auxiliaries of a Generating Unit.</td>
</tr>
<tr>
<td><strong>User</strong></td>
<td>A term utilized in various sections of Grid Code to refer to the persons using the Karnataka Power Grid, as more particularly identified in each section of the Grid Code. In the General Conditions the term means any person to whom the Grid Code applies.</td>
</tr>
<tr>
<td><strong>User Site</strong></td>
<td>A site owned (or occupied pursuant to a lease, licence or other agreement) by a User in which there is a connection point.</td>
</tr>
<tr>
<td><strong>Utility</strong></td>
<td>Any person or entity engaged in generation, transmission, Bulk Supply or Distribution and Retail</td>
</tr>
</tbody>
</table>
supply of energy, as the case may be.

**VVN**L Visveswaraya Vidyut Nigama Limited.

***

**SECTION-3**

**MANAGEMENT OF GRID CODE**

3.1 **INTRODUCTION:**

3.1.1 The Karnataka Power Transmission Corporation Limited (KPTCL), which is the State Transmission Utility (STU) for the State of Karnataka, which also holds the Transmission License and Bulk Supply License is required to implement and comply with the Karnataka Electricity
Grid Code (KEGC), herein after called GRID CODE, and to carry out periodic review and amendments of the same with the approval of Karnataka Electricity Regulatory Commission (KERC). A Review Panel shall be constituted by the Transmission Licensee, as required in this Section, comprising of the representatives of the Users of the Transmission System.

3.1.2 No change in this GRID CODE, however small or big, shall be made without being deliberated upon and agreed to by the GRID CODE Review Panel and approved by KERC.

3.1.3 The Transmission Licensee will be responsible for managing and implementing the GRID CODE for discharging its obligations with the Users. The Transmission Licensee will not be, however, required to incur any expenditure on account of travel etc., of any other member of the panel other than its own representative.

3.2 OBJECTIVE:

3.2.1 The objective of this Section is to define the method of management of GRID CODE documents, implementing any changes/modifications required and the responsibilities of the constituents (Users) to effect the change.

3.3 GRID CODE REVIEW PANEL:

3.3.1 The Chairperson of the Grid Code Review panel shall be an Engineer of the Transmission Licensee not below the rank of Chief Engineer Electricity of the Transmission Licensee. The Member Secretary of the Panel shall also be nominated by the Transmission Licensee. The Panel shall consist of the following members on the recommendations of the heads of the respective organizations:
(a) One Chief Engineer or General Manager of Karnataka Power Corporation Limited (KPCL).
(b) One Chief Engineer of Visveswaraya Vidyut Nigama Limited (VVNL).
(c) One representative at senior executive level from National Thermal Power Corporation Limited (NTPC).
(d) One representative at senior executive level from Power Grid Corporation of India Limited (PGCIL).
(e) One representative at senior executive level from Southern Regional Electricity Board (SREB).
(f) One representative at senior executive level from each Distribution & Retail Supply Licensee.
(g) One representative at senior executive level from each of the IPPs feeding the Karnataka State Power Grid feeding not less than 50 MW.
(h) One representative from all the IPPs and CPPs of small Power Plants of less than 50 MW capacity on rotation basis.
(i) One nominee from KERC.

3.3.2 Any other member can be co-opted as a member of the panel when directed by KERC.

3.3.3 The functioning of the panel shall be co-ordinated by the Transmission Licensee. The Member Secretary nominated by the Transmission Licensee shall be the convener.

3.3.4 The Transmission Licensee shall inform all the Users, the names and addresses of the Panel Chairperson and the Member Secretary at least 7 days before the first Panel meeting. Any subsequent changes shall also be informed to all the users by the Transmission Licensee. Similarly, each User shall inform the names and
designations of their representatives to the Member Secretary of the Panel, at least three days before the first Panel meeting, and shall also inform the Member Secretary in writing regarding any subsequent changes.

3.4 FUNCTIONS OF THE REVIEW PANEL:

3.4.1 The functions of the Review Panel are as follows:

(a) Maintenance of the GRID CODE and its working under continuous scrutiny and review.

(b) Consideration of all requests for review made by any User and publication of their recommendations for changes to the GRID CODE together with reasons for such changes.

(c) Issue of guidance on interpretation and implementation of the GRID CODE.

(d) Examination of the problems raised by any User.

(e) Ensuring that the changes/modifications proposed in the GRID CODE are consistent and compatible with Indian Electricity Grid Code (IEGC).

(f) Analysis of major grid disturbances soon after their occurrence.

(g) Constitute a committee containing experts in the field of protection, including at least one member from the Transmission Licensee for coordination and monitoring of protection functions for the entire grid, duly making the required studies for the protective relay settings.

The Review Panel may hold any number of meetings as required subject to the condition that at least one meeting shall be held in every three months. Sub-meetings may be held by the Transmission Licensee with the User to discuss individual requirements and with
groups of Users to prepare proposals for Panel meeting for a decision.

3.5 **REVIEW AND REVISIONS:**

3.5.1 The Users seeking any amendment to the Grid Code shall send written requests to the Member Secretary of the panel with a copy to KERC. If the request is sent to KERC directly, the same shall be forwarded to the Transmission Licensee. The Transmission Licensee shall, in consultation with the Distribution & Retail Supply Licensees, Generating Companies, Central Transmission Utility (CTU) and SREB and such other persons as the KERC may direct, review the GRID CODE provisions. The Transmission Licensee shall examine the proposed changes/modifications and circulate the same along with its comments to all the panel members for their written comments within a reasonable time frame.

3.5.2 All the comments received shall be scrutinized and compiled by the Transmission Licensee. These along with Transmission Licensee’s comments shall be sent to all the members for their response in favour or otherwise, for the proposed change/modification. If necessary, the Transmission Licensee shall convene a meeting of the panel for deliberations. The Member Secretary shall present all the proposed revisions of the Grid Code to the panel for its consideration.

3.5.3 Based on the response received, the Transmission Licensee shall finalize its recommendation regarding the proposed modification /
amendment and submit the same along with all the related correspondence to KERC for approval.

3.5.4 The Transmission Licensee shall send the following reports to the KERC at the conclusion of each review meeting of the panel:

(a) Reports on the outcome of such review.
(b) Any proposed revision to the Grid Code as the Transmission Licensee reasonably thinks necessary for achievement of the objectives referred to in the relevant paragraphs of the Transmission licence.
(c) All written representations and objections submitted by the Users at the time of review.

3.5.5 All revisions to the Grid Code require the approval of KERC. The Transmission Licensee shall publish revisions to the Grid Code, after the approval of KERC. The Transmission Licensee may submit proposals for relaxation in such cases where Users have difficulties in meeting the requirements of the Grid Code.

3.5.6 Any change from the previous version shall be clearly marked in the margin. In addition, a revision sheet shall be placed at the front of the Revised Version noting the number of every changed Sub-section, together with reasons for such change.

3.5.7 The Transmission Licensee shall keep copies of the Grid Code with the latest amendments and shall make it available at a reasonable cost to any person requiring it. The Transmission Licensee shall keep an up to date list of recipients of all the copies of the Grid Code.
4.1 **INTRODUCTION:**

The System Planning specifies the technical and design criteria and procedures to be adopted by the Transmission Licensee for the planning and development of the Transmission System. The Users of
the Transmission System shall take the "System planning" into account for planning and development of their own System.

4.1.1 Reinforcements and extensions to the System arise due to many reasons of which a few are mentioned below:
1. A development on a User's System already connected to the Transmission System as a User development.
3. The need to increase System capacity, removal of operational constraints, maintenance of Security Standards and meeting general increases in Demand.
5. Cumulative effects of any combination of the above four.

4.1.2 The work of such reinforcement and extension to the Transmission System may also involve work at a connecting point (entry or exit) of a Generating Company/Distribution Licensee to the Transmission System.

4.1.3 The development of the Transmission System must be planned in advance duly allowing sufficient lead time, considering the following:
1. Time required for obtaining all the necessary statutory approvals like PTCC clearance, Forest clearance, Railway clearance, clearance from aviation authorities, National highways, State highways etc., and the right of way permissions wherever required,
2. Time required for detailed engineering, design and construction work to be carried out. This "System Planning", therefore, enforces the time scales for exchange of information between the Transmission Licensee
and the User(s). All the concerned parties, wherever appropriate, shall have due regard to the confidentiality of such information.

4.2 **Objective:**

4.2.1 This Section formulates the Standards and Procedures for the "System Planning" to enable the Transmission Licensee in consultation with the Users, for evolving an efficient, co-ordinated, secure and economical Transmission System for the Karnataka Power Grid in order to satisfy the requirements of Demand and Generation.

4.3 **Perspective Plan:**

4.3.1 The load forecasting shall be the primary responsibility of Distribution Licensee within his area of supply. The Distribution and Retail Supply Licensees shall determine the peak load and energy forecasts of their areas, for each category of loads for each of the succeeding 10—15 years and submit the same annually by 31st March to the Transmission Licensee. These shall include the details of demand forecasts, data methodology and assumptions on which the forecasts are based. The load forecasts shall be made for each interconnection point with the Karnataka Power Grid and other Users and shall include the annual peak load and energy projections along with the daily load curves. These forecasts shall be updated annually and also whenever major changes are made in the existing system. Wherever these forecasts take into consideration demands for power exceeding 5 MW by a single consumer, the Distribution Licensee shall personally satisfy himself regarding the materialization of such a demand.

4.3.2 The Transmission Licensee shall also review the methodology and assumptions used by the Distribution Licensees in making the load
forecasts, in consultation with them. The resulting overall forecast will form the basis of planning for expansion of Transmission System, which will be carried out by the Transmission Licensee. To maintain the reliability of the interconnected Regional Power Systems, all participants must comply with the planning criteria/guidelines of CEA as updated from time to time.

4.3.3 The Transmission Licensee shall be responsible to prepare and submit a long term (ten years) plan to the KERC for Generation expansion and the Transmission System expansion to meet the future demand in accordance with Section 16.9 of the Transmission Licence. The planning shall be in conformity with the national perspective for Power Generation and Transmission plan prepared by the CEA.

4.3.4 The Transmission Licensee shall forecast the demand for power within the area of supply for each of the succeeding ten years and provide to the KERC the details of demand forecasts, data, methodology and assumptions on which the forecasts are based. These forecasts shall be periodically updated. A least cost generation plan for the Karnataka State has to be prepared to meet the ten years' load demand according to the forecast, after examining the economic, technical and environmental aspects of all available alternatives and taking into account the existing contracted generation resources and effects of demand management. Similarly, a long term (ten years) plan for the Transmission System compatible with the above load forecast and generation plan shall be prepared and submitted to KERC. This shall also include provision for reactive compensation needed for the Transmission System.
4.3.5 The Transmission Licensee shall be responsible for integrating the load forecasts submitted by each of the Distribution and Retail Supply Licensees and determining the long-term (10 years) load forecasts for the State. For determining the requirements for the entire State, an appropriate diversity factor from the data available for the previous years shall have to be chosen. The Transmission Licensee shall satisfy itself regarding the probability of materialization of bulk loads of consumers with demands above 5 MW in consultation with the Distribution and Retail Supply Licensees concerned.

4.4 **Planning Standards and Procedures:**

4.4.1 The power generation expansion planning shall be carried out in accordance with the "Power Supply Planning and Security Standard" approved by KERC under Section 16 of the Transmission Licence. The Transmission System shall be planned in accordance with the "Transmission System Planning and Security Standard" approved by KERC under Section 16.3 of the Transmission Licence.

4.5 **Planning Data Requirement:**

4.5.1 To enable the Transmission Licensee to discharge its responsibilities under the Transmission Licence by conducting System Studies and preparation of perspective plans for demand, generation and transmission as detailed in this section, all the Users shall furnish all the data to the Transmission Licensee from time to time detailed under Data Registration Section and categorized as Planning Data (PD), vide Annexe "A".

4.5.2 To enable the Users to Co-ordinate planning, design and operation of their plants and systems with the Transmission System they may seek certain salient data of the Transmission System as applicable
to them. The Transmission Licensee shall supply these data from time to time as detailed under Data Registration Section and categorized as Detailed Transmission System Data vide Annexe "B".

4.6 In addition to the above provisions, the planning code of Indian Electricity Grid Code (IEGC) which call for data exchange shall also apply to the Generating Companies, CPPs, IPPs, Transmission Licensee, Utilities and Distribution and Retail Supply Licensees regarding generation / transmission of energy from Inter State Transmission Systems.

4.7 The one time data shall be submitted within 6 months from the date the Grid Code comes into effect, by all the concerned to the Transmission licensee. The data other than this one time data shall be made available to the Transmission Licensee on first of April and first of October every year.
**ANNEXE A**

**PLANNING DATA REQUIREMENTS**
(Clause 4.5.1)

**PART-I - GENERATION**
(To be furnished by the Generating Company to the Transmission Licensee)

A-1  **Standard Planning Data (Generation)**

**THERMAL**

1. **GENERAL:**

<p>| | |</p>
<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Site:</td>
<td>i. Furnish location map to scale showing roads, Railway lines, Transmission lines, Rivers, and reservoirs if any.</td>
</tr>
<tr>
<td></td>
<td>ii. Coal /Fuel linkage (like Liquid Natural Gas, Naptha, LSHS/FO etc.)</td>
</tr>
<tr>
<td></td>
<td>iii. Furnish information on means of coal transport from Coal transport from Coal mines in case of pithead stations or means of coal carriage if coal is to be brought from distance.</td>
</tr>
<tr>
<td></td>
<td>iv. In case of other fuels, Furnish details of sources of fuel and their transport.</td>
</tr>
<tr>
<td></td>
<td>v. Water Sources (Furnish information on availability of water for operation of the power Station).</td>
</tr>
<tr>
<td></td>
<td>vi. Environmental (State whether forest, lands mining clearance areas are affected).</td>
</tr>
</tbody>
</table>

2. **Site Map:**
(To scale) | Showing area required for power station coal linkage, coal yard, water pipe line, ash disposal area, colony etc. |
3. Approximate period of construction.

4. Guaranteed Plant Load Factor.

5. Annual Generation.

II. Connection:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Point of connection</td>
<td>Furnish single line diagram of the proposed connection with the system.</td>
</tr>
<tr>
<td>2. Step up voltage for connection in KV</td>
<td></td>
</tr>
</tbody>
</table>

III. Station Capacity:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total Power Station capacity (MW).</td>
<td>MW</td>
</tr>
<tr>
<td>2. No. of Units and Unit size MW.</td>
<td>State whether development will be carried out in phases and if so, furnish details.</td>
</tr>
<tr>
<td>3. Generator Unit Data:</td>
<td></td>
</tr>
<tr>
<td>i. Steam Turbine- State Type, capacity, steam pressure, steam temperature etc.</td>
<td></td>
</tr>
<tr>
<td>ii. Generator:</td>
<td></td>
</tr>
<tr>
<td>a) Type</td>
<td></td>
</tr>
<tr>
<td>b) Rating (MVA)</td>
<td></td>
</tr>
<tr>
<td>c) Terminal Voltage (KV)</td>
<td></td>
</tr>
<tr>
<td>d) Rated Power Factor</td>
<td></td>
</tr>
<tr>
<td>e) Reactive Power capability (MVAr) in the range 0.95 leading and 0.85 lagging.</td>
<td></td>
</tr>
<tr>
<td>f)短路比</td>
<td></td>
</tr>
<tr>
<td>g)直接轴短暂电抗（%额定 MVA）</td>
<td></td>
</tr>
<tr>
<td>h)直接轴次暂态电抗（%额定 MVA）</td>
<td></td>
</tr>
<tr>
<td>i)辅助电源需求</td>
<td></td>
</tr>
<tr>
<td>iii. 发电机变压器 / 站用变压器</td>
<td></td>
</tr>
<tr>
<td>a)额定容量 (MVA)</td>
<td></td>
</tr>
<tr>
<td>b)电压比 (HV/LV)</td>
<td></td>
</tr>
<tr>
<td>c)触点变化范围（+% to -%）</td>
<td></td>
</tr>
<tr>
<td>d)正序阻抗（满载正序）。</td>
<td></td>
</tr>
</tbody>
</table>

**A.1.2 火电：**

1. **一般：**

| 1. 站 |
| 提供位置图，显示道路、铁路线路、输电线路。 |
| 2. 站图（按比例） |
| 地图显示拟建的坝、水库区、水导线系统、前湾、发电站等。 |
| 3. 淹没区 |
| 提供淹没区、森林区、农田区等信息。 |
| 4. 大致建设期。 |
| 5. 年发电量（主能量，次能量） |

**II. 连接：**

| 1. 连接点 |
| 提供单线图，显示拟建的单线图。 |
connection with the transmission system

2. Step up voltage for connection KV

III. **Station Capacity:**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total power station capacity MW</td>
<td>State whether development would be carried out in phases and if so furnish details</td>
</tr>
<tr>
<td>2. No. of Units and unit size MW.</td>
<td></td>
</tr>
</tbody>
</table>

IV. **Generation Unit Data:**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Operating Head (In Mtr)</td>
<td>Maximum</td>
<td>Minimum</td>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>2. Turbine</td>
<td>State type and capacity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Generator</td>
<td>a) Type</td>
<td>b) Rating (MVA)</td>
<td>c) Terminal Voltage (KV)</td>
<td>d) Rated Power Factor</td>
</tr>
<tr>
<td></td>
<td>e) Reactive Power capability (MVar) in the range of 0.95 leading and 0.85 of lagging.</td>
<td>f) Short Circuit Ratio</td>
<td>g) Direct axis transient reactance (% on rated MVA)</td>
<td>h) Direct axis Sub-transient reactance (% on rated MVA)</td>
</tr>
<tr>
<td></td>
<td>i) Auxiliary Power Requirement</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 4. Generator - Transformer | a) Type  
b) Rated Capacity (MVA)  
c) Voltage Ratio HV/LV  
d) Tap change Range (+ % to - %)  
e) Percentage Impedance (Positive sequence at Full load rating) |
A.2 Detailed Planning Data (Generation)

A.2.1 Thermal Power Stations

I. General:

1. Name of Power Station:
2. No. and capacity of Generating Units (MW):
3. Ratings of all major equipments:
   (a) Boilers and Major accessories (Steam temperature/pressure)
   (b) Coal Mill (KW)
   (c) Feed water Pumps (KW)
   (d) ID Fans (KW)
   (e) Turbines
   (f) Alternators
   (g) Generating Unit Transformers (MVA)
   (h) Station Transformers
4. Auxiliary Transformers (MVA)
5. Single line diagram of Power Station and switchyard.
6. Relaying and metering diagram.
7. Neutral Grounding of Generating Units.
8. Excitation control (type - E.g. Static Excitation System, Fast Brushless)
9. Earthing arrangements with earth resistance values.

II. Protection and Metering:

1. Full description including settings for all relays and protection systems installed on the generating Unit, Generating Unit Transformer, Auxiliary Transformer and electrical motor of major equipment listed, but not limited to, under Sl.3 (General).
2. Full description including settings for all relays installed on all outgoing feeders from Power Station switchyard, tie circuit breakers, incoming circuit breakers.
3. Full description of inter-tripping of Breakers at the point or points of Connection with the Transmission system.
4. Most probable fault clearance time for electrical faults on the user's system.
5. Full description of operational and commercial metering schemes.

III. Switchyard:

1. In relation to interconnecting transformers between High Voltage Transmission System and the Generator Transformer High Voltage System:
   (a) Rated MVA
   (b) Voltage Ratio
   (c) Vector Group
   (d) Positive sequence reactance (maximum, minimum, normal Tap(% on MVA)
   (e) Positive sequence resistance (maximum, minimum, normal Tap (% on MVA)
   (f) Zero sequence reactance (% on MVA)
   (g) Tap changer Range (+ % to - %) and steps
   (h) Type of Tap changer (OFF/ON)
   (i) Details of Reactors, and other circuits connected to tertiary winding of ICT.

2. In relation to switchgear including circuit breakers, isolators on all circuits connected to the points of connection:

   (a) Rated Voltage (KV)
   (b) Type of Breaker (MOCB/ABCBC/SF6)
   (c) Rated short circuit breaking current (kA) 3 Phase
   (d) Rated short circuit breaking current (kA) 1 Phase
   (e) Rated short circuit making current (kA) 3 Phase
   (f) Rated short circuit making current (kA) 1 Phase
(g) Provisions of auto reclosing with details.

3. Lightning Arresters, Technical data.
4. Communication- Details of PLCC equipments installed at points of connections.
5. Basic Insulation Level (KVp).
   (a) Bus bar.
   (b) Switchgear.
   (c) Transformer Bushings.
   (d) Transformer windings.

IV. Generating Units:

A. Parameters of Generating Units:

1. Rated terminal voltage (KV)
2. Rated MVA
3. Rated MW
4. Inertia constant (MW Sec./MVA) of Generator, Exciter and Turbine
5. Short circuit ratio
6. Direct axis synchronous reactance (% on MVA)
7. Direct axis transient reactance (% on MVA)
8. Direct axis sub-transient reactance (% on MVA)
9. Quadrature axis synchronous reactance (% on MVA)
10. Quadrature axis transient reactance (% on MVA)
11. Quadrature axis sub-transient reactance (% on MVA)
12. Direct axis transient open circuit time constant (Sec)
13. Direct axis sub-transient open circuit time constant (Sec)
14. Quadrature axis transient open circuit time constant (Sec)
15. Quadrature axis sub-transient open circuit time constant (Sec)
16. Stator Resistance (Ohm)
17. Stator leakage reactance (Ohm)
18. Stator time constant (Sec)
19. Rated Field current (A)
20. Open Circuit saturation characteristic for various terminal voltages giving the exciting current to achieve the same.
21. Generator Capability Curve

B. Parameters of Excitation control system:

1. Type of Excitation
2. Maximum Field voltage
3. Minimum Field voltage
4. Rated Field voltage
5. Gain Factor
6. Feed Back Strength
7. Time constant for control amplifier
8. Time constant for Exciter
9. Time constant for Feed Back
10. Output voltage of control amplifier
11. Maximum Output voltage of control amplifier
12. Minimum Output voltage of control amplifier
13. Details of excitation loop in Block Diagrams showing transfer functions of individual elements using IEEE symbols along with set values.
14. Dynamic characteristics of over - excitation Limiter
15. Dynamic characteristics of under -excitation Limiter

Note: Using IEEE Committee Report symbols the following parameters shall be furnished: D, A, BSx, K_a, K_e, K_i, T_a, Y_f, V_f(max), V_f(min), S_a, S_b.
C. Parameters of Governor:

1. Governor average gain (MW/Hz)
2. Speeder motor setting range
3. Time constant of steam or fuel Governor valve
4. Governor valve opening limits.
5. Governor valve rate limits.
6. Time constant of Turbine
7. Governor Block Diagram showing transfer functions of individual elements using IEEE symbols along with set values.

V. Plant Performance:

<table>
<thead>
<tr>
<th>1. Daily Demand Profile (Last Year)</th>
<th>Peak and Average in time marked 30 minutes throughout the day.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Daily Demand Profile (forecast)</td>
<td>In time marked 30 minutes throughout the day.</td>
</tr>
<tr>
<td>3. Units Generated (MU)</td>
<td></td>
</tr>
<tr>
<td>4. Units consumed in Auxiliaries (MU)</td>
<td></td>
</tr>
<tr>
<td>5. Units supplied from system to Auxiliary Load</td>
<td></td>
</tr>
<tr>
<td>6. Seasonal Generation</td>
<td></td>
</tr>
</tbody>
</table>

D. Operational Parameters:

1. Min. notice required for synchronizing a Generating Unit from De-synchronization.
2. Min. time between synchronizing different generating units in a Power station.
3. The minimum block load requirements on synchronizing.
4. Time required for synchronizing a generating unit for the following conditions:
(a) Hot
(b) Warm
(c) Cold

5. Maximum generating unit loading rate for the following conditions:
   (a) Hot
   (b) Warm
   (c) Cold

6. Minimum load without oil support (MW)
A.2.2 Hydroelectric Stations:

I. **General:**

1. Name of Power Station:
2. No. and capacity of Units (MVA)
3. Expected level of Generation
4. Period of Generation (in months) per year
5. Whether the plant is based on water released from dam/canal for irrigation purposes
6. Rating of all major equipments.
   (a) Turbine (HP):
   (b) Generators (MVA):
   (c) Generator Transformers (MVA):
   (d) Auxiliary Transformers (MVA):
7. Single line diagram of power station and switchyard.
8. Relaying and metering diagram.
   (a) Neutral grounding of generator.
   (b) Excitation control.
   (c) Earthing arrangements with earth resistance values.

II. **Reservoir Data:**

1. **Salient features:**

1. Type of Reservoir: Multipurpose/Power only
2. Operating Table with:
   (i) Area capacity curves,
   (ii) Unit capability at different net heads,
(iii) FRL/MDDL.

III. Protection:

1. Full description including settings for all relays and protection systems installed on the Generating units, generator transformer, auxiliary transformer and electrical motor of major equipment {included}, but not limited to those listed under General.
2. Full description including settings for all relays installed on all outgoing feeders from Power Station switchyard, tie breakers, and incoming breakers.
3. Full description of inter-tripping of breakers at the point or points of connection with the Transmission system.
4. Most probable fault clearance time for electrical faults on the user's system.

IV. Switchyard:

1. Interconnecting Transformers:
   (a) Rated MVA
   (b) Voltage Ratio
   (c) Vector Group
   (d) Positive sequence reactance for maximum, minimum, normal Tap (% on MVA)
   (e) Positive sequence resistance of maximum, minimum, normal Tap (% on MVA).
   (f) Zero sequence reactance (% on MVA)
   (g) Tap changer Range (+ % to - %) and steps
   (h) Type of Tap changer (OFF/ON)

2. Switchgear (including circuit breakers, Isolators on all circuits connected to the points of connection):
(a) Rated voltage (KV)
(b) Type of Breaker (MOCB/ABC/6)
(c) Rated short circuit breaking current (KA) 3 Phase.
(d) Rated short circuit breaking current (KA) 1 Phase.
(e) Rated short circuit making current (KA) 3 Phase.
(f) Rated short circuit making current (KA) 1 Phase.
(g) Provisions of auto reclosing with details.
(h) Details of Instrument Transformers.

3. Lightning Arresters, Technical Tada.

4. Communications: Details of communications equipment installed at points of connections.

5. Basic Insulation level (KV):
   (a) Bus bar
   (b) Switchgear
   (c) Transformer Bushings
   (d) Transformer Windings

6. Generating Units:

i. Parameters of Generator:
   (a) Rated terminal voltage (KV)
   (b) Rated MVA
   (c) Rated MW
   (d) Inertia constants (MW Sec./MVA) of Generator, Exciter and Turbines
   (e) Short circuit ratio
   (f) Direct axis synchronous reactance. (% on MVA)
   (g) Direct axis transient reactance. (% on MVA)
(h) Direct axis sub-transient reactance (% on MVA)
(i) Quadrature axis synchronous reactance (% on MVA)
(j) Quadrature axis sub-transient reactance (% on MVA)
(k) Direct axis transient open circuit time constant (SEC)
(l) Direct axis sub-transient open circuit time constant (SEC)
(m) Stator Resistance (Ohm)
(n) Stator leakage reactance (Ohm)
(o) Stator time constant (Sec)
(p) Rated Field current (A)
(q) Open Circuit saturation characteristics of the generator for various terminal voltages giving the compounding current to achieve this.
(r) Generator Capability Curve

ii. **Type of Turbine:**
(a) Operating Head (Mtr.)
(b) Discharge with Full Gate Opening (Cumecs)
(c) Speed Rise on total Load throw off (%) 

iii. **Parameters of Excitation Control system**
(AS APPLICABLE TO THERMAL POWER STATIONS)

iv. **Parameters of Governor**
(AS APPLICABLE TO THERMAL POWER STATIONS)

7. Operational parameters:
   (a) Minimum notice required for synchronizing a Generating Unit from De-synchronization.
   (b) Minimum time between synchronizing different Generating Units in a power station.
   (c) Minimum block load requirements on Synchronizing.
A.3 Planning Data Generation

(For submission on request by Transmission Licensee)

I. For Thermal Power Stations:

A. General:

1. Detailed Project report.
2. Status Report:
   (a) Land
   (b) Coal
   (c) Water
   (d) Environmental clearance
   (e) Rehabilitation of displaced persons.
3. Techno-economic approval by Central Electricity Authority.
4. Approval of State Government/Govt. of India.
5. Financial tie-up.

B. Connection:

1. Report of studies of parallel operation with transmission system:
   (a) Load flow studies
   (b) Stability studies
   (c) Short Circuit studies

2. Proposed connection with Transmission system:
   (a) Voltage
   (b) No. of circuits
II. Hydroelectric Power Stations:

A. General:

1. Detailed Project Report
2. Status Report
   (a) Topographical survey
   (b) Geological Survey
   (c) Land
   (d) Environmental clearance
   (e) Rehabilitation of displaced persons
3. Techno-economic approval by the Central Electricity Authority.
4. Approval of State Govt./Govt. of India.
5. Financial Tie-up.

B. Connection:

1. Reports of studies for parallel operation with KPTC system.
   (a) Load flow studies
   (b) Short Circuit studies
   (c) Stability studies
2. Proposed Connection with Transmission System:
   (a) Voltage
   (b) No. of Circuits.
   (c) Point of connection.
PART - II - DISTRIBUTION

(To be furnished by the Distribution Company to the Transmission Licensee)

B.1 Standard Planning Data Distribution

I. General:

1. Area map (to scale) Marking the area in the map of Karnataka for which Distribution License is applied.
2. Consumer Data Furnish categories of consumers, their Nos. connected loads
3. Reference to Electrical Divisions presently in charge of the distribution

II. Connection:

1. Points of connection: Furnish single line diagram showing points of connection.
2. Voltage of supply at points of Connection:
3. Names of Grid Sub-Station feeding the points of connection:

III. Lines and Sub-stations:

1. Line Data: Furnish length of line and voltages within the area.
2. Sub-station Data: Furnish details of 33/11 KV Sub-station, 11/0.4 KV Sub-stations, capacitor installations:

IV. Loads:

1. Loads drawn at points of connection:
2. Details of loads fed at Give name of consumer, voltage of supply,
EHV if any: contract demand and name of Grid Sub-station from which line is drawn, length of EHT line from Grid Sub-station to consumer's premises.

V. **Demand Data (For all Loads 5 MW and above):**

1. Type of load: State whether furnace loads, rolling mills, traction loads, other industrial loads, pumping loads etc.
2. Rated voltage:
3. Electrical loading of equipment: State number and size of motors, types of drive and control arrangements.
4. Sensitivity of load to voltage and frequency of supply:
5. Maximum harmonic content of load:
6. Average and maximum phase unbalance of load:
7. Nearest sub-station from which load is to be fed:
8. Location map to scale: Map shall show the location of load with reference to lines and sub-stations in the vicinity.

VI. **Load Forecast Data:**

1. Peak load and energy forecast for each category of loads for each of the succeeding 10 years.
2. Details of methodology and assumptions on which forecasts are based.
3. If supply is received from more than one sub-station, the sub-station wise break up of peak load and energy projection for each category of loads for each of the succeeding 10 years along with estimated daily load curve.

4. Details of load 5 MW and above.
   (a) Name of prospective consumer.
   (b) Location and nature of load/complex.
   (c) Sub-station from which to be fed.
   (d) Voltage of supply.
   (e) Phasing of load.

B.2 Detailed Planning Data (Distribution)

A. General:
1. Distribution map (To scale). Showing all lines up to 11 KV and sub-stations belonging to the Licensee.
2. Single line diagram of distribution system (showing distribution lines from points of connection with transmission system 33/11 KV Sub-station, 11/0.4 KV sub-station, consumer bus if fed directly from Transmission system)
3. Numbering and nomenclature of lines and sub-stations (Identified with feeding Grid sub-stations of the transmission system and concerned 33/11 KV sub-station of supplier).
4. Monitoring of Transmission and Distribution Losses (Methods adopted for reduction of losses to be stated).

B. Connection:
1. Points of connection (Furnish details of existing arrangement of Connection)
2. Details of metering of points of connection.
C. **Loads:**
1. Connected Load (Category-wise) - Furnish consumer details, No. of consumers category-wise details of loads 1 MW and above)
2. Information on diversity of load and coincidence factor.
3. Daily demand profile (current and forecast) on each 33kV/11kV sub-station.
4. Cumulative Demand Profile of Distribution (current and forecast)

**B.3 Detailed Planning Data (Distribution)**
(For submission on request by the Transmission Licensee)

I. **General:**

1. Detailed Project Report (For new and system improvement schemes)
2. Status Report
   (a) Load Survey
   (b) Load forecast for next five years
3. Single Line Diagram showing proposed new lines and Sub-stations
4. Techno Economic approval by CEA

II. **Connection:**

1. Points of connection as applied for
   (a) New
   (b) Upgrading existing connection
2. Changes in metering at points of connection

III. **Loads:**

1. Details of loads as per the forecast in next five years
2. Distribution of loads 33/11 kV Sub-station wise projected for next five years

3. Details of major loads of 1 MW and above to be contracted for next five years

IV. Improvement Schemes for reduction of Sub-transmission and Distribution Losses:

1. Statement of estimated Subtransmission and Distribution losses for next five years

2. Brief indication of improvement scheme for reduction of losses
   (excerpts from Detailed Project Report)
   (a) New lines
   (b) Upgrading of lines
   (c) New Sub-station/Upgrading of Sub-stations
   (d) Rearrangement of loads
   (e) Installation of capacitors.
ANNEXURE B
(Clause 4.5.2)

PLANNING DATA REQUIREMENTS - TRANSMISSION
(To be furnished to the User on request by the Transmission Licensee)

B.1 Standard Planning Data (Transmission)

Note: - The compilation of the data is the internal matter of the Licensee, and as such the Licensee shall make arrangements for getting the required data from different Departments of the Licensee to up-date its standard planning Data in the format given below:

1. Name of the line: (Indicating Power stations and Sub-stations to be connected)
2. Voltage of line (KV):
3. No. of Circuits:
4. Route length (CKM):
5. Conductor sizes:
6. Line parameters (PU on 100 MVA base or ohmic values): (a) Resistance/KM 
   (b) Inductive Reactance /KM 
   (c) Suctance/KM
7. Approximate power flow MW & MVAr:
8. Terrain of route: Give information regarding nature of terrain i.e., forestland, fallow land, agricultural and river basin, hill slope etc.
9. Route Map (to scale): Furnish topographical map showing
the proposed route showing existing power lines and telecommunication lines

10. Purpose of connection:
Reference to scheme, wheeling to other States etc.

11. Approximate period of construction:

B.2 Detailed System Data (Transmission)

Note: The compilation of the data is the internal matter of the Transmission Licensee, and as such the he shall make arrangements for getting the required data from different departments of the Licensee to update his Standard Planning Data in the format given below.

A. General:

(a) Single line diagram of the Transmission system up to 33 KV bus at grid sub-station:

(b) Name of sub-station

(c) Power Station connected

(d) Number and length of Circuits

(e) Interconnecting transformers

(f) Sub-station bus layouts

(g) Power Transformers

(h) Reactive compensation equipment
   1. The details of capacitors installed
   2. Additional capacitors to be commissioned along with additional loads.

(i) Lightning Arresters
B. **Sub-station layout diagrams showing:**
(a) Bus bar layouts
(b) Electrical circuitry, lines, cables, transformers, switchgear etc
(c) Phasing arrangements
(d) Earthing arrangements
(e) Switching facilities and interlocking arrangements
(f) Operating voltages
(g) Numbering and nomenclature
   i. Transformers
   ii. Circuits
   iii. Circuit Breakers
   iv. Isolating switches

C. **Line parameters: (For all Circuits)**

(a) Designation of line
(b) Length of line (KM)
(c) No. of circuits, size and type of conductor, thermal rating
(d) Per Circuit values
   i. Operating voltage (KV)
   ii. Positive phase sequence reactance - ohms/KM
   iii. Positive phase sequence resistance - ohms/KM
   iv. Positive phase sequence suceptance - mhos/KM
   v. Zero phase sequence reactance - ohms/KM
   vi. Zero phase sequence resistance - ohms/KM
   vii. Zero Phase sequence suceptance - mhos/KM
D. **Transformer parameters: (For all transformers)**

(a) Rated MVA
(b) Voltage Ratio
(c) Vector Group
(d) Positive sequence reactance on rated MVA base (Max., min. & normal)
(e) Positive sequence resistance on rated MVA base (max., min. & Normal)
(f) Zero sequence reactance on rated MVA base
(g) Tap change range (+% to -%) and steps
(h) Details of tap changer (OFF/ON)
(i) Neutral Grounding Transformer/Resistor Values

E. **Equipment Details: (For all Sub-stations):**

(a) Circuit Breakers
(b) Isolating switches
(c) Current Transformers
(d) Potential Transformers
(e) Lightning Arresters

F. **Relaying and metering:**

(a) Relay protection installed for all transformers and Feeders along with their settings and level of co-ordination with other users.
(b) Metering Details:

G. **System studies:**

(a) Load flow studies (Peak and lean load for maximum Hydro and maximum Thermal Generation)
(b) Transient stability studies for 3 Ph. Fault in critical lines, and single pole reclosing for 400 KV Lines.
(c) Dynamic stability studies
(d) Short circuit studies (3 Ph. and single Ph. to earth)
(e) Transmission and distribution losses in the system.

H. **Demand Data: (For all sub-stations)**
(a) Demand Profile (Peak and lean load)
   i. Current
   ii. Forecast for next 5 years

I. **Reactive Compensation equipment:**
(a) Type of equipment (fixed or variable)
(b) Capacities and/or inductive rating (Voltage and MVAr) or its operating range.
(c) Details of control
(d) Point of Connection to the system.

B.3 **Detailed Planning Data (Transmission)**
*(To be submitted on request by the Transmission Licensee)*

I. **General:**

1. Detailed Project Report (For new and System Improvement Schemes)
2. Status Report
3. Line:
   (a) Route Survey
   (b) Forest Clearance
4. Sub-Stations
   (a) Land
   (b) Environmental Clearance
   (c) Techno-economic approval by CEA
(d) Financial Tie-up

II. **Connection:**

1. Single Line Diagram showing position of connection
2. Sub-station layout diagram
   (a) New
   (b) Addition and Alteration
3. Revised system studies with changed parameters
4. Point of Connection
   (a) Voltage
   (b) Length of circuit
   (c) Circuit parameters
   (d) PLCC facilities
   (e) Relaying with inter tripping arrangements to inter trip system breaker at point of connection to isolate on fault
   (f) Metering at point of connection.
SECTION-5
CONNECTION CONDITIONS

5.1 Introduction:
This Section of the Grid Code formulates the technical, design and operational criteria to be complied with by the Users connected to the Transmission System.

5.2 Objective:
The objective of this Section is to ensure the following:
1. All Users or prospective Users are treated equitably.
2. Any new Connection shall not impose any adverse effect on the existing Users. New Connections shall not suffer adversely due to existing Users.
3. A System of acceptable quality is ensured by specifying the required minimum standards for the design and operational criteria to assist the Users in their requirement to comply with the Licence obligations.
4. The ownership and responsibility for all the items of equipment is clearly specified in the "Site Responsibility Schedule" for every site where a connection is made.

5.3 Site Responsibility Schedule:
5.3.1 For every connection to the Transmission System for which a connection agreement is required, the Transmission Licensee shall prepare a Schedule of Equipment, pursuant to the relevant Connection Agreement, with the information supplied by the Users. This Schedule, called a "Site Responsibility Schedule" shall state the following for each item of equipment installed at the Connection Site: -
1. Ownership of the Plant/Apparatus.
2. Responsibility for control of Plant/Apparatus.
3. Responsibility for operation of Plant/Apparatus.
4. Responsibility for maintenance of Plant/Apparatus.
5. Responsibility for all matters relating to safety of any person at the Connected Site.
6. The management of the Site.

5.3.2 Each Site Responsibility Schedule, in addition to the above, shall contain all other information setout in the Grid Code. An illustrative "Site Responsibility Schedule" is furnished in the Annexe "C".

5.3.3 The User owning the Connection Site shall provide reasonable access and other required facilities for other Users whose equipments are installed/to be installed at the Connection Site for installation, operation and maintenance etc.

5.4 System Performance:

5.4.1 The design and construction of all the equipments connected to the Transmission System shall satisfy the relevant Indian Standard Specifications. In case of equipment for which the Indian Standard Specifications do not exist, the appropriate IEC, or IEEE or other International Standards shall apply.

5.4.2 Installation of all electrical equipment shall comply with IE Rules.

5.4.3 For every new Connection sought, the Transmission Licensee shall specify the Connection Point and the supply voltage, along with the metering and protection requirements as specified in the "Metering and Protection Standard".

5.4.4 The operation of the Transmission System shall be in accordance with the "Transmission System Operating Standard". The User shall
however be subject to the grid discipline prescribed by the SLDC and SRLDC.

5.4.5 The Insulation Co-ordination of the Users' equipment shall conform to the applicable Indian Standards/Code of practices. The rupturing capacity of the switchgear shall not be less than that notified by the Transmission Licensee based on system studies.

5.4.6 The equipment for data transmission and communications for all the Power Stations existing at the time the Grid Code comes into effect shall be owned and maintained by the STU unless alternative arrangements are mutually agreed to. For new Power Stations the same shall be owned and maintained by the STU, unless otherwise mutually agreed to by the Generating Company.

5.5 **Connection Points:**

5.5.1 **Generating Company:** The voltage at the point of connection with the Transmission System may be 400/220/110/66 kV or as agreed with the STU. The connection point shall be the outgoing feeder gantry point of the Power Station switchyard. The Metering Point shall be the outgoing feeder. All the protection and metering equipment within the perimeter of the Power Station shall be owned and maintained by the Generating Company. From the outgoing point onwards, the Transmission Licensee shall maintain all the equipment.

5.5.2 **Distribution & Retail Supply Licensee:** The voltage at the point of connection to the Transmission System may be 33/11 kV or as specified by the Distribution & Retail Supply Licensee. The connection point shall be the outgoing feeder gantry of the Transmission Licensee’s sub-station. The metering point shall be at the outgoing feeder. All the terminal, communication, protection
and metering equipment within the premises of the Transmission Licensee shall be owned and maintained by the Transmission Licensee. The respective Distribution & Retail Supply Licensees shall maintain all the equipment from the outgoing feeder gantry onwards.

5.5.3 **Connections with other Transmission Systems**: - The connection, metering and protection scheme, metering point and the voltage for the Southern Regional Transmission System shall be in accordance with the mutual agreement between the CTU and the STU. The connection for other neighbouring state transmission systems shall also be in accordance with the mutual agreement between the concerned state Licensees.

5.5.4 **CPPs and Bulk Consumers**: - The voltage can be as agreed to by the Transmission/Distribution & Retail Supply Licensees. The connection point shall be the feeder gantry on their premises. CPPs and Bulk consumers shall own their respective sub-stations. The metering point shall be at the Transmission Licensee's sub-station for the sale of power to the Distribution & Retail Supply Licensee. The metering point for the sale of power to the bulk consumers and CPPs shall be at the point of connection with their systems.

5.6 **Procedure for Applications for connections to the Transmission System**:

5.6.1 Any User seeking to establish new or modified arrangements for connection to and/or use of the Transmission System shall submit the following report, data and undertaking along with an application duly observing the procedural requirements to the Transmission Licensee:
Report stating the purpose of the proposed connection and/or modification, connecting site, description of apparatus to be connected or modification to the Apparatus already connected. Applicable data along with the data listed in the Annexe A and B of Section 4.

Confirmation that the prospective installation complies with the provisions of IE Rules and IE Act.

Construction Schedule and target completion date.

An undertaking to the effect that the User shall abide by the Grid Code and the provisions of IE Rules, for installation and operation of the Apparatus.

For special loads like Arc Furnaces, Rolling Mills etc., Real and Reactive Power Values of the Load with Time and Harmonic Level.

5.6.2 The Transmission Licensee shall make a formal offer to the User within two months from the date of receipt of application containing all the above information along with any such information as may be reasonably required. The break-up cost of the works to be undertaken shall be furnished duly classified under the sub-heads like materials, labour and supervision. The offer made shall be subject to obtaining or in compliance with the required consents, approvals, permissions for right of way or other requirements, whether of statutory or contractual nature or otherwise.

5.6.3 An User whose development requires the Transmission Licensee to obtain any of the consents, approvals, permissions, and right of ways or to comply with any other requirements mentioned in this Grid Code shall:
i. Provide necessary assistance, supporting information or evidence; and

ii. Ensure attendance by such witnesses as the Transmission Licensee may reasonably request.

5.6.4 The estimated time schedule for completion of such works should also be identified taking into account the time required to obtain statutory clearances, wayleaves etc., wherever necessary. In respect of offers for modifications to the existing Connections, the terms shall also take into account, the existing Connection Agreement.

5.6.5 If the nature of complexity of the proposed Development is such that the prescribed time limit for making the offer is not considered adequate, the Transmission Licensee shall make a preliminary offer within the prescribed time limit indicating the extent of additional time required for more detailed analysis of the issues.

1. On receipt of the preliminary offer, the User shall indicate promptly whether the Transmission Licensee should proceed further to make a final offer within the extended time limit.

2. If necessary, the Transmission Licensee may require the User to furnish some or all of the Detailed Planning Data at this stage itself in advance of the normal time limit.

5.6.6 All offers (other than the preliminary offers) including revised offers shall remain valid for 60 (sixty) days from the date of issue of the offer. The Transmission Licensee shall make a revised offer, upon request by a User, if necessitated by changes in data furnished earlier by the User.
5.6.7 The User shall furnish the relevant Detailed Planning Data to the Transmission Licensee within thirty days of acceptance of an offer or such longer period as the Transmission Licensee may agree in a particular case.

5.6.8 Wherever the State Power Grid is connected with the Inter State Transmission System, the provisions of Connection Conditions of IEGC will prevail.

5.7 **Right to Reject an Application:**

5.7.1 The Transmission Licensee may reject any application for connection to and/or use of the Transmission system under the following conditions:

1. If the proposed connections violate any provisions under the Transmission License,
2. If the proposed works stated in the application do not lie within the purview of the Licence or do not conform to the provisions of the Grid Code,
3. If the applicant fails to give the undertakings according to clause 5.6.1 of this section.

5.7.2 In the event of an offer becoming invalid or rejected by an applicant within the validity period, no further action shall be taken by the Licensee on the Connection applications unless it is substantially different from the original application with regard to the system changes.

5.8 **Connection Agreements:**

5.8.1 A connection Agreement, or the offer for a connection Agreement, shall include, as appropriate within its terms and conditions, the following:
1. A condition requiring both the parties to comply with the Grid Code.

2. Details of connection and/or use of the system.

3. Details of any capital related payments and any other payments and deposits etc., arising from necessary reinforcement or extension of the System.

4. A "Site Responsibility Schedule" detailing the division of responsibility at the Connection Sites in relation to ownership, control, operation and maintenance of Plant and Apparatus and to safety of persons.

5.8.2 If any offer was originally made upon an application for Development by a User, which is subject to changes in the design parameters, the Transmission Licensee shall make a revised offer to the User including revised terms and extended time limit for submission of data. This revised offer shall form the basis of any Connection Agreement.
ANNEXE C
SITE RESPONSIBILITY SCHEDULE

Name of the power station/substation owner:

Telephone No:

Fax No:

Permanent Address:

<table>
<thead>
<tr>
<th>Item of Plant or Apparatus</th>
<th>Plant Owner</th>
<th>Responsibility for</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>6666 kV Switch Yard *</td>
<td></td>
<td>Safety</td>
<td></td>
</tr>
<tr>
<td>Feeder</td>
<td></td>
<td>Control</td>
<td></td>
</tr>
<tr>
<td>Generating Units</td>
<td></td>
<td>Operation</td>
<td></td>
</tr>
<tr>
<td>Generating Unit Transformers</td>
<td></td>
<td>Maintenance</td>
<td></td>
</tr>
</tbody>
</table>

*All HV Apparatus on any Connection Site shall be shown on one Schematic diagram, which shall include details of the following:

1. Busbars
2. Circuit Breakers
3. Isolator
4. Bypass facilities
5. Earthing switches
6. Maintenance earths
7. Overhead line entries
8. Overhead line traps
9. Cable and Cable sealing ends
10. Generating Unit
11. Generating Unit Transformers
12. Generating Unit Auxiliary Transformers including Low Voltage Circuit Breakers
13. Station Service Transformers including Low Voltage Circuit Breakers
14. Capacitors including Synchronous Condensers
15. Series or Shunt Reactors
16. Grid Transformers (Inter Connecting Transformers)
17. Tertiary windings
18. Earthing and Auxiliary Transformers
19. Three phase voltage transformers
20. Single phase voltage transformers and phase identity
21. Surge Arresters
22. Neutral earthing arrangements on HV Plant
23. Current transformers

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SECTION-6
OPERATION PLANNING AND SECURITY

6.1 **Introduction:**
This Section contains the guidelines for the Transmission Licensee to carry out the Planning of Power System Operation, including interface co-ordination with the Users, fixing the parameters for Operation margin, contingency reserve, demand control etc., for a satisfactory grid operation and System Integrity.

6.2 **Objective:**
The Objective of this Section is to define the process, which will allow the Transmission Licensee to minimize transmission outages by coordination with the Generating Companies and other Users’ outages while maintaining system security to the extent possible. This section also provides guidelines for setting out reserves available from:

1. External Connections,
2. System Operation and
3. Demand control.

6.3 **Demand Estimation:**
6.3.1 The estimation of Demand shall be carried out both in the long time scale to ensure system/plant margins and ratings and in the shorter time scale to assist in the frequency control according to "Schedule of Dispatch" indicated in the "Power Generation Management and Operating Standard".

6.3.2 The Distribution & Retail Supply Licensee shall formulate a long-term demand forecast considering the previous financial year as base and projecting the Demand for the succeeding 5 years. During
this process he shall review the status of loads materializing as per the previous load forecast. 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. 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, and energy conservation. The aggregate energy and peak load requirements at each connection point shall be estimated taking into account the distribution losses. The Distribution & Retail Supply Licensee shall forward the long term demand forecast for each connection point with the Transmission System for his area of supply on annual basis to the Transmission Licensee and KERC along with the following details on the basis of which the forecast is made:

(a) Data,
(b) Methodology,
(c) Assumptions

6.3.3 It shall be the responsibility of all the Distribution & Retail Supply Licensees to fully co-operate with the Transmission Licensee in preparation of demand forecasts for the entire Karnataka State.

6.3.4 The Distribution/Retail Supply Licensees shall provide their estimates of Demand at each Connection Point for the period from 1st July to 30th June by 31st March of each year on a year ahead basis. This shall be updated for every month subsequently in the previous month on month ahead basis, and in the previous day on day ahead basis as required by the Transmission Licensee.
6.3.5 Based on the data furnished by the Distribution/Retail Supply Licensees, the Transmission Licensee shall make monthly peak and lean period demand estimates for the year ahead, daily peak and lean period demand estimates for the month ahead, and hourly estimates for the day ahead demands.

6.3.6 The Transmission Licensee shall use hourly generation summation figures and CPP import/export figures to meet the Demand estimation.

6.3.7 The Distribution & Retail Supply Licensees shall provide to the SLDC, estimates of loads that may be shed, when required, in discrete blocks with details of arrangements of such load shedding.

6.3.8 All the data shall be collected in accordance with the procedures agreed to between the Transmission Licensee and each User.

6.3.9 The SLDC shall maintain a database of the total demand for the State on an hourly basis.

6.4 Data requirements:

6.4.1 The Users and the Transmission Licensee shall provide all the data indicated in the Annexure D to the SLDC. Each Generating Company shall submit to the SLDC in writing during the month of June every year, the Generation Planning Parameters and the performance chart of the Generator to be applied from the beginning of July onwards, for the entire year. This information shall also be furnished when required initially under the PPA. The Generator Performance chart shall be for each specific Generating Unit and include the details of the Generator Transformers and demonstrate the limitation of reactive capability of the Generating Unit at the Transmission System voltage of 10% above normal as and when required by the SLDC.
6.5 **Release of Circuits and Generator Units included in the outage plan:**

6.5.1 Notwithstanding provision in any approved outage plan, no cross boundary circuits or Generating Units of a Generating Company shall be removed from service without specific release from the SLDC. This restriction shall not apply to individual Generating Units of a CPP. Once an outage has commenced, and if any delay in restoration is apprehended, the SLDC or the User concerned shall inform the other party promptly together with the revised estimation of restoration time.

6.6 **Transmission Outage Planning:**

6.6.1 The SLDC shall produce a yearly transmission Outage program for the period from 1st of July to 30th of June. All the Generating Companies and Distribution & Retail Supply Licensees shall furnish, their proposed outage programs containing the identification of the Unit, Sub-station, etc., date of start of outage and duration of outage, in writing to the SLDC for the year ahead (from 1st of July to 30th of June) by first of August each year. The SRLDC shall inform its proposed outage that would affect the Transmission System to the SLDC by first November of each year. The SLDC shall interact with all the above said agencies and prepare an optimum draft outage plan to minimize interruptions to consumers to the extent possible, if necessary by rescheduling any of the outages. The finally agreed transmission outage plan, taking into account the regional and user requirements shall be prepared by the SLDC and furnished to all the Users by the first of March every year.

6.6.2 The outage plan shall be reviewed by the SLDC quarterly in consultation with all the concerned agencies mentioned above regarding any changes necessitated during the period and the revised outage plan shall be intimated to all the Users. The Users’ requests for additional outages, if any, shall be considered by the SLDC and accommodated
to the extent possible. Such changes shall be informed by the SLDC promptly to all the concerned. The Distribution & Retail Supply Licensees shall also inform the consumers through publications in local newspapers whenever interruptions to power supply would affect them.

6.7 **Operating Margin:**

6.7.1 Operating Margin comprises of Contingency Reserve and Operating Reserves required for the satisfactory operation of the Power System to cover uncertainties in Plant availability, variations in Demand forecasts, loss of External Connections, loss of Generation, constraints in the Transmission System and all other factors.

6.7.2 The required Contingency Reserve shall be decided by the SLDC on the basis of historical trends in the reduction of availability of the Generating Companies, imports through inter-state tie lines and increases in Demand forecast during real time operation.

6.7.3 Whenever the Contingency Reserve is to be held by a Thermal Power Station, the SLDC shall include the same in the Indicative Running notification and/or subsequent dispatch instructions by which the Generating Company is notified of and/or instructed, that the Generating Unit shall be operated in the Contingency Reserve mode.

6.8 **Demand Control:**

6.8.1 Automatic load shedding shall be resorted to by means of the Under Frequency Relays as per the directions of the SLDC to preserve the overall integrity of the Power System. The number and size of the discrete blocks with the associated Low Frequency setting predetermined for Automatic Load Shedding shall be determined on rotational basis in consultation with the Distribution &
Retail Supply Licensee. The frequency settings of these relays shall be coordinated in consultation with the SREB.

6.8.2 Whenever restoration of large portions of the total demand disconnections effected by the Automatic load shedding is not possible within a reasonable time, the SLDC shall implement additional disconnections manually, to restore an equivalent amount of demand disconnected automatically. The Distribution & Retail Supply Licensees shall help the SLDC in identifying such load blocks. No load shed by the operation of automatic load shedding devices shall be restored without specific directions from the SLDC.

6.8.3 Planned Manual Disconnection shall be implemented by the SLDC when there is a shortfall in Generation, or Constraints in Transmission, or reduction of imports through External Connection etc., requiring Demand Control over prolonged period. In such cases a rotational load shedding scheme shall be adopted to ensure equitable treatment for all Customers as far as practicable.

6.8.4 Emergency Manual Disconnection to deal with unacceptable voltage and frequency levels, thermal over loads etc shall be implemented by the SLDC only when loss of Generation, mismatch of Generation with the demand or Constraints in the Transmission System, result in an emergency situation, requiring load shedding at short notice or no notice, to maintain a Regulating Margin.

6.9 System Security:

6.9.1 All Users shall co-operate with the STU so that the respective sections of the Power System operate in synchronism with Karnataka Power Grid. The Transmission Licensee shall operate the inter-zonal links and ensure smooth exchange of power in the Southern Grid among the component State Grids.
6.9.2 The Transmission System shall not be isolated from the Southern Grid except under the following conditions:

1. Emergency situations that may result in the total grid collapse.
2. Isolation of the system to prevent serious damage to equipment.
3. Instructions of the SLDC or the SRLDC under operating conditions.
4. Operation of under frequency/islanding scheme as approved by the SREB.

6.9.3 Complete synchronism shall be restored as soon as the conditions permit. The restoration process shall be supervised by the SLDC.

6.9.4 The Transmission Lines of 66 kV and above, and the Inter Connecting Power Transformers, except radial lines which do not affect the grid operation, should not be opened without instructions or prior clearance from the SLDC unless under emergencies when prior clearance is not possible. All such isolations that do not fall under the guidelines approved by the SREB shall be put up before the Review Panel for ratification. The SLDC may refer the matter to the Review Panel if it feels that the reasons for not taking prior permission are not justified.

6.9.5 Any tripping of the Transmission Lines or Power Transformers whether actuated by protective relays or manually, shall be promptly reported to the SLDC by the Engineer in Charge of the sub-station at the earliest along with the reasons for such tripping and the time required for restoration. The report shall accompany all the relevant information/data including the outputs of the Disturbance Recorder, Sequential Event Recorder etc., required for the purpose of analysis.
6.9.6 The governors of all the Generating Units of capacity 50 MW and above, except run of the river hydroelectric power stations without pondage, and steam turbines of combined cycle gas turbines, shall be in free operation at all times. If for any reason, the governors are locked, the same should be intimated to the SLDC along with the reasons and duration of such operation, which has to be ratified by the Review Panel subsequently. The Load Limiter, Automatic Turbine Run-up System (ATRS), Turbine Supervisory Coordinated Control System etc shall not be used to suppress the normal governor action in any manner. No dead bands and time delays shall be deliberately used.

6.9.7 All Generating Units shall be capable of and shall not be prevented from picking up 5% extra load, more than the declared Maximum Continuous Rating, for at least five minutes or within the technical limits specified by the manufacturers, when the frequency falls due to a system contingency. In case any Generating Unit of 50 MW and above does not meet this requirement for any period, the Generating Company should intiate the same to the SLDC. The concerned constituents shall make all efforts to compensate this shortfall in spinning reserve by maintaining an extra spinning reserve on their other Generating Units run by them.

6.9.8 In case the frequency falls below 49.5 Hz, all the partly loaded Generating Units shall pick up additional load at a faster rate, according to their capability. The SLDC in consultation with the SRLDC and the Distribution & Retail Supply Licensees shall prepare a plan for automatic load relief during the low frequency conditions. In case the frequency rises to 50.5 Hz or higher, neither any Generating Unit which is in stand by made shall be synchronized.
with the Grid nor Active Power generation at any generating station increased irrespective of the type and ownership.

6.9.9 No Generating Company shall suddenly increase/decrease its generation without prior intimation to the SLDC except during emergencies or to prevent an imminent danger to any costly equipment. Similarly no Distribution & Retail Supply Licensee shall cause a sudden decrease/increase in its load due to imposition/lifting of power cuts etc., without prior intimation and consent of the SLDC, particularly when the frequency is less than 49.5 Hz or above 50.5 Hz.

6.9.10 All Generating Units shall have Automatic Voltage Regulators in operation, with appropriate settings. If for any reason it has to be operated without the same, the SLDC shall be intimated immediately with reasons and duration of such operation and its concurrence obtained. The metering and protection systems shall be provided according to the "Metering and Protection Standard". The settings of protective relays shall be coordinated as per the plan separately finalized by the "Protection Committee" to be constituted by the Review Panel/Transmission Licensee in consultation with the SREB wherever required.

6.9.11 Users shall comply with the following applicable standards issued separately:


6.9.12 The Users shall make all possible efforts to ensure that the grid frequency always remains within the 49.0 - 50.5 Hz band, the frequency range within which the steam turbines conforming to the IEC specifications can safely operate.
ANNEXURE D
OPERATION PLANNING DATA

A. Outage Planning Data:

1. Demand Estimates:
Estimated aggregate annual sales of energy in million units and peak and lean demand in MW and MVAr at each connection point for the period from 1st July of current year to 30th of June of the next year shall be submitted before 31st March of current year.
Estimated aggregate monthly sales of energy in million units and peak and lean demand in MW and MVAr at each connection point for the next month shall be submitted before 15th of current month.
Hourly demand estimates for the day ahead shall be submitted at 10.00 hours every day.

2. Estimates of load shedding:
Details of discrete load blocks that can be shed to comply with instructions issued by the SLDC when required, from each connection point soon after connection is made.

3. Year ahead outage program:
(For the period 1st July to 30th June)
i. Generators’ outage program:
Information shall be furnished within 1st August each year:
(a) Identification of Generating Unit.
(b) MW, which will not be available as a result of outage.
(c) Preferred Start dates and Start-time or range of start dates and Start Times and period of outage.
(d) If outages are required to meet statutory requirements, then the latest date by which outage must be taken.

ii. **SRLDC's Year ahead outage program:**

   (Affecting transmission system)

   Information shall be furnished within 1st November of each year:
   (a) MW, which will not be available as a result of outage from Imports through external connections.
   (b) Start-Date and Start-Time and period of outage.

iii. **CPP's Year ahead outage program:**

   Information to be furnished within 1st of August of each year:
   (a) MW which will not be available as a result of outage.
   (b) Start-Date and Start-Time and period of outage.

iii) **Distribution Company’s Year ahead outage program:**

   Information shall be furnished within 1st of August of each year:
   (a) Load in MW not to be availed from any connection point.
   (b) Identification of connection point.
   (c) Period of suspension of drawal with Start-date and Start-time.

iv) **The Licensee’s overall outage program:**

   Information shall be furnished before 1st March of each year.
   (a) Report on proposed outage program to the SRDLC by 1st November each year.
   (b) Release of finally agreed outage plan.

**B. Generation Scheduling Data:**

Schedule and dispatch shall be submitted by:
a) Day ahead hourly MW/MVAR availability (0.00 - 24.00 Hrs.) of all Generator Units at 10.00 Hrs. every day.
b) Day ahead hourly MW import/export from CPP's of all Generator units at 10.00 Hrs. every day.
c) Status of Generating Unit AVR in service (Yes/No) all Generator units at 10.00 Hrs. every day.
d) Status of Generating Unit speed controls system Governor in service (Yes/No) all Generator units at 10.00 Hrs. every day.
e) Spinning Reserve capability (MW) of all Generator units at 10.00 Hrs. every day.
f) Backing down capability with/without Oil support (MW) all Thermal Generator units at 10.00 Hrs. every day.
g) Hydro Reservoir level & restrictions all Generator units at 10.00 Hrs. every day.
h) Generating Units Hourly summation outputs of all Generator units at 10.00 Hrs. every day.
i) Day ahead hourly MW entitlements from Central Sector Generation at 11.00 Hrs. every day.

C. **Capability data:**

(a) Generators shall submit to the Transmission Licensee up to date capability curves for all Generating Units on receipt of request from the Transmission Licensee.

(b) CPPs shall submit to the Transmission Licensee net return capability that shall be available for export/import from Transmission system on receipt of request from Transmission Licensee.
D. **Response to Frequency change:**

(a) Primary Response in MW at different levels of loads ranging from minimum Generation to Registered capacity for frequency changes resulting in fully opening of governor valve.

(b) Secondary Response in MW to frequency changes.

E. **Monitoring of Generation:**

(a) Generators shall provide hourly generation summation to the SLDC on Real Time basis in the first week of the succeeding month.

(b) CPP’s shall provide hourly export/import MW to the SLDC on Real Time basis in the first week of the succeeding month.

(c) Logged readings of Generators to the SLDC whenever required.

(d) Detailed report of generating Unit tripping on monthly basis.

F. **Essential and non-essential load data:**

Schedule of essential and non-essential loads on each discrete load block for purposes of load shedding shall be furnished as soon as possible after connection.

G. **Protection Data:**

a) Generators/CPP’s shall submit details of protection requirement and schemes installed by the m as per the detailed planning data under Sub-Station "Protection and Metering" as applicable to Detailed Planning Data.

b) The Transmission Licensee shall submit details of protection equipment and schemes installed by them.
c) Detailed system Data required for relaying and metering of the Transmission lines and Sub-Stations in relation to connection with any User as applicable to detailed Planning data.

H. **Metering Data:**

(a) Generators/CPPs shall submit details of metering equipment and schemes installed by the m.

(b) Detailed Planning Data under Sub-Station "Protection and Metering" as applicable to Detailed Planning Data.

(c) The Transmission Licensee shall submit details of metering equipment and schemes installed by them.

***
SECTION-7
SYSTEM OPERATION METERING, PROTECTION, DESPATCH AND CONTROL

7.1 **Scope:**
7.1.1 This Section specifies the procedure to be adopted for the scheduling of despatch of the Generating Units to meet the demand and drawal allocations, the management of frequency and voltages in the EHV system, the minimum requirement of protection levels and metering specifications for the various components of the system.

7.2 **Objective:**
7.2.1 The main objective of this section is to formulate the detailed methodology to be followed by the Transmission Licensee for healthy operation of the system to meet the specified standards of electrical power under normal operating conditions as follows:
   i. Laying down the procedures for the function of SLDC,
   ii. Defining the responsibilities of the Transmission Licensee and other Users,
   iii. Specify the minimum standards of protection to be employed in the Power Stations, Sub-stations, and Transmission and Distribution Systems by the concerned agencies.

7.3 **General:**
7.3.1 It is essential that all the Users of the Transmission System shall fully co-operate with the Transmission Licensee to maintain the System integrity and healthy operation. The entire Grid is one unit right from the point of generation to the ultimate consumers and the
various agencies involved in the management of the Power System shall provide a healthy coordination to the SLDC who will be the central agency for operation of the State Grid. The success or failure of the Power System entirely depends on the full cooperation of all the participants in this endeavor.

7.4 **System operation and despatch:**

7.4.1 The Transmission Licensee shall operate and maintain the SLDC fully equipped for an optimum and reliable operation of the Power System.

7.4.2 The estimation of daily Load Demand on day ahead basis shall be carried out, in general, and furnished to the SLDC by the Distribution Licensees keeping in view the following aspects:
   i. Outage Planning/Scheduled rostering,
   ii. Historical data of load for the same month/day/time,
   iii. Previous day's Demand,
   iv. Present weather conditions and meteorological reports,
   v. Requirement of meeting important loads on festivals etc.,
   vi. Force Majeure conditions such as floods, riots etc.,
   vii. Vacations, Sundays and other holidays,
   viii. Number and frequency of breakdowns and their recovery period.

7.4.3 All the generating companies shall furnish their generator availability details of the quarter hourly MW/MVAR/Maximum MWhrs by 10 AM of each day for the next day.

7.4.4 The Despatch instructions shall be issued by the SLDC by the telephone message/fax message/e-mail and contain the following:
i. Specific generating company to which the instruction applies,

ii. The output to which the instruction applies,

iii. The start time wherever the same is different from the time the instruction is issued,

iv. Issue time of instruction,

v. Name of the sender of despatch instruction,

vi. Spinning Reserve (MW).

7.4.5 The "Power Supply Management and Operation Standard", which is issued separately, forms an integral part of this Section. The standard specifies the procedures for the following aspects to be followed by SLDC and all the Users for the satisfactory operation of the system:

i. Quality of Power Supply - clause no.3.0

ii. Outage Planning - clause no.4.0

iii. Generation Scheduling and Despatch - clause no.5.0

iv. Frequency Management - clause no.6.0

v. Voltage and Reactive Power management - clause no.7.0

vi. Black-start operations - clause no.8.0

vii. Schedule of Despatch - clause no.9.0

viii. Standards to be met by the generating companies - clause no.10.0

ix. Generation Reserve - clause no.11.0

x. Monitoring of generation - clause no.12.0

The SLDC and all the Users shall strictly follow these procedures.

7.4.6 The Karnataka Power Grid normally operates in synchronism with the Southern Grid and the SRLDC has the overall responsibility of enforcing the Grid discipline and managing the frequency in the
region. The SLDC shall follow the instructions of SRLDC in this regard for backing down/shutting down generation, regulating the load flow etc., to meet the objective. The SLDC shall accordingly instruct the generating companies to regulate their generation and hold reserves of Active and Reactive Power within their respective declared parameters.

7.4.7 The SLDC shall also regulate the load as may be necessary to meet this objective. The Transmission System Voltage levels can be affected by regional operation. The Transmission Licensee shall optimize voltage management by adjusting the Transformer taps to the extent available and switching the capacitors/reactors and take such other operational steps indicated in the Transmission Management and Operating Standard. The SLDC shall also instruct the generating companies to regulate the MVAr generation within their declared parameters. The SLDC shall also instruct the Distribution Licensees to regulate their demand if necessary. The Distribution and Retail Supply Licensees shall also participate in the voltage management by regulating their drawal and by installing compensatory equipment as may be required. If acceptable voltage levels are still not reached by these measures, the Transmission Licensee shall take necessary steps to augment the voltage level such as strengthening of the Transmission System and/or installation of requisite shunt capacitors adding compensatory equipment, building new lines etc., to meet the voltage criteria.

7.4.8 A regular procedure shall be evolved by the Transmission Licensee with all the generating companies for a pattern of
generation reduction at different Power Stations when the system load comes down after the peak load period. Schedule and Despatch procedure shall be suitably modified from time to time keeping in view of the tariff agreements for achieving optimum cost of power as soon as such arrangements are reached with the generating companies.

7.4.9 The Distribution and Retail Supply Licensee shall maintain a Power Factor of not less than 0.90 lag as required in the "Distribution System Operation and Maintenance Standard" and furnish all the data required by the SLDC to ascertain the Reactive Power flow to their distribution system. The SLDC may also instruct the Distribution and Retail Supply Licensees to maintain appropriate Power Factor and take all measures minimize Reactive Power drawal.

7.5 **Metering and Protection:**

7.5.1 The metering and protection to be provided at the Power Stations, Sub-stations and the distribution systems shall meet the specific requirements of the "Metering and Protection Standard" issued separately. This standard also forms an integral part of this Section. All users shall cooperate with the Transmission Licensee to ensure correct and appropriate settings of protection to achieve an effective, discriminatory removal of faulty equipment within the target clearance time specified in this Standard. Protective Relay settings shall not be altered, or protection bypassed and/or disconnected, without consultation and agreement of all the affected Users. In the case where Protection is bypassed and/or disconnected by agreement, then the cause must be rectified and protection restored to normal condition as
quickly as possible. If agreement has not been reached, the electrical equipment shall be removed from service forthwith.

7.6 **Fire Protection:**

7.6.1 All adequate precaution shall be taken and protection shall be provided against fire hazards to all apparatus in the System conforming to the relevant Indian Standard Specifications and/or provisions of IE Rules 1956 as amended from time to time and the Tariff Advisory Committee recommendations.

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SECTION-8
MONITORING OF GENERATION AND DRAWAL

8.1 **Scope:**
8.1.1 This Section covers the procedure to be followed by the SLDC for monitoring the Generating Output, Active and Reactive reserve capacity required for evaluation of the performance of Power Plant. The monitoring of scheduled Drawal is important to ensure that the Transmission Licensee contributes towards improving the Regional performance, and observes Grid discipline.

8.2 **Objective:**
8.2.1 The objective of this Section is to define the responsibilities of all Users in monitoring the performance of their Generating Units, and the Distribution & Retail Supply Licensee’s compliance with the scheduled Drawal.

8.3 **Monitoring Procedure:**
8.3.1 For the effective operation of the Transmission System, it is important that the declared availability of the Generating Company is realistic and the departures are continuously fed back to the Generating Company for effecting the required improvement. The Transmission Licensee shall continuously monitor the Generating Unit outputs and bus voltages. More stringent monitoring shall be performed at any time when there are reasons to believe that the Generating Company’s declared availability may not match with the actual availability, or declared output does not match with the actual output.

8.3.2 The Transmission Licensee shall inform the Generating Company, in writing, if continual monitoring demonstrates an apparent persistent or material mismatch between the dispatch instructions.
and the Generating Unit output or breach of the "Connection
Conditions". This more stringent monitoring shall be carried out by
the SLDC, if agreement is not reached between the concerned
parties on the performance of the Generating Unit. The results of
stringent monitoring shall be reported by the SLDC to the
Generating Company. Continual discrepancies shall be resolved
at appropriate levels for improving the performance, providing
more realistic declarations or correcting any breach of
"Connection Conditions".

8.3.3 The Generating Companies shall provide to the SLDC hourly
generation summation outputs wherever no automatic transmitting
metering or SCADA equipment exists. All the CPPs (capacity above
5 MW) shall provide to the SLDC hourly export/import MW and
MVAr. The Generating Company shall provide other logged
readings, which the SLDC may reasonably require, for monitoring
purposes wherever SCADA data is not available.

8.3.4 The connection points with the Inter State Transmission Systems
including the Transmission Lines and Substations of the Central
Transmission Utility, the metering arrangements including
installation, testing, operation and maintenance of meters and
collection, transportation and processing of data required for
accounting of energy exchanges and the average frequency, on
15 minute time block basis shall be provided by the Central
Transmission Utility / SRLDC. Processed data on meters along with
the data relating to the declared capability and schedules etc.,
shall be furnished by SRLDC to the Transmission Licensee, every
month, for billing purposes.
8.4 Monitoring of Drawal by the Grid:

8.4.1 The SLDC shall continuously monitor actual MW Drawal (Import/Export) against the scheduled drawal from the Generating Companies, by the use of SCADA equipment wherever available, or otherwise using available metering. The SLDC shall request the SRLDC and adjacent States as appropriate to provide any additional data required to enable this monitoring to be carried out.

8.4.2 The SLDC shall also monitor the actual MVAr Import/Export. This will be used to assist in the voltage management in the Transmission System.

8.5 Generating Unit Trippings:

8.5.1 The Generating Companies shall promptly inform the tripping of a Generating Unit, with reasons, to the SLDC in accordance with the guidelines given in the operational event/accident reporting Section. The SLDC shall keep a written log of all such trippings, including the reasons for the purpose of demonstrating the effect on system performance and identifying the need for remedial measures. The Generating Companies shall submit a detailed report of their Generating Unit trippings to the SLDC every month.

8.6 Data Requirements:

8.6.1 The Generating Companies and the CPPs shall submit the following data on monthly basis to the SLDC in the first week of every succeeding month:

1. Generating Companies:
   a) Hourly Generation and summation on real time basis,
   b) Logged readings of Generating Units as required,
   c) Detailed report of the Generator Unit trippings.
1. **CPPs (above 5 MW):** Hourly export/import MW on real time basis.

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SECTION-9

CONTINGENCY PLANNING

9.1 Scope:

9.1.1 This Section formulates the recovery procedure to be followed by all the Users in the event of failure of Karnataka Power Grid, or the Southern Grid resulting in total or partial collapse of the System causing blackouts.

9.2 Objective:

9.2.1 The objective of this Section is to define the responsibilities of all the Users for achieving the fastest possible recovery of the Grid in the event of a failure in the Transmission System, or any sudden loss of Generation or a blackout caused due to the failure of the Southern Grid.

9.2.2 The procedure to be adopted for a fast recovery shall take into account the following:

i. The essential loads to be restored immediately,

ii. The capabilities of the Power Stations,

iii. The possible transfer of power from the neighbouring Systems through Inter State Transmission Lines,

iv. The extent of immediate availability of power from the Central Sector Power Stations.

9.2.3 The main objective is to achieve the following:

i) Restoration of the total system and associated demand in the shortest possible time

ii) Resynchronization of parts of the system which have ceased to be in synchronism,
iii) To ensure that the communication arrangements for use in circumstances of serious disruption to the System, are available to enable senior management representatives of the SLDC, the Transmission Licensee and the Users who are authorized to take decisions on behalf of the Transmission Licensee or the User,

iv) To ensure that the Transmission System can operate in the event the SLDC is incapacitated for any reason.

9.3 Strategy:
9.3.1 The situation prevailing prior to the occurrence of the contingency, e.g. availability of specific Power Stations, Transmission Lines, and load Demands will largely determine the restoration procedure to be adopted in the event of a total blackout. The SRLDC and the SLDC shall coordinate in determining the extent of the problem. The SLDC shall inform all the Users of the situation and advise them to follow the strategy as outlined in this Section for restoration. The Personnel authorized by the Users shall be readily available at the Users' end for communication and acceptance of all operational communications throughout the period of contingency. The use of Communication channels shall be restricted to the operational communications only, till normalcy is restored.

9.4 Total Regional Blackout:
9.4.1 The SLDC shall instruct all the Generating Companies having Power Stations with Black-Start capabilities, to commence their pre-
planned Black-Start procedure. The SLDC may also request the CPPs to extend start-up power supply to the Power Stations of the Generating Companies, wherever they may be feasible.

9.4.2 The SLDC shall prepare the Transmission System for restoration by creating discrete power islands with no interconnection.

9.4.3 Close coordination with Distribution & Retail Supply Licensees shall be maintained during the restoration process to form and make available discrete load blocks to maintain the stability of the Generating Units, immediately after they become available in individual islands.

9.4.4 Power Stations, to which the start up power supply is made available, shall sequence their start up activities to match their auxiliary power demand with the supply available.

9.4.5 The Engineer-in-charge of the Power Station shall inform the SLDC as and when the Generating Units become available to take load, so that the SLDC may assess the load Demand which the Generating Unit is likely to pickup on closing of the circuit breaker.

9.4.6 The SLDC, in close coordination between the Generating Companies and Distribution & Retail Supply Licensees shall take the following steps:

i. Formation of discrete power islands with one Generating Unit feeding some of the local loads,

ii. Extend such islands by adding more Generating Units and more loads in a coordinated manner maintaining Load-Generation Balance,

iii. Synchronize these islands to form a larger, more stable island,
iv. Wherever facilities for synchronization are available, the same shall be made use of to bring the complete system into synchronism.
v. Regional or Inter-state assistance, wherever appropriate, shall be utilized in the above process.

9.5 **Total State Transmission System Blackout:**
9.5.1 The Strategy shall be the same as in the case of "Total Regional Blackout". The SLDC shall carryout simultaneous action to draw power from radial feeders from Southern Region and Maharashtra State System.

9.6 **Partial Transmission System Blackout:**
9.6.1 The SLDC shall ensure with the Users that the security of the healthy part of the Transmission System is not disturbed.
9.6.2 The SLDC shall gradually extend the healthy system to provide start-up power to the appropriate Generating Units.
9.6.3 With the close coordination of the Generating Companies and the Users the SLDC shall gradually restore the load to match with the generation immediately after the availability of the Generating Units.
9.6.4 All the Users shall take care to ensure that the Load-Generation balance is maintained at all times under the directions of the SLDC.

9.7 **Responsibilities:**
9.7.1 The SLDC shall maintain a record of Power Station Black Start capabilities and associated Power Station Black Start operation plans.
9.7.2 The Transmission Licensee shall prepare, distribute, and maintain up-to-date Black-Start procedures covering the restoration of the Transmission System following total or partial blackouts. The Users shall agree to these Black Start procedures and promptly inform the SLDC in advance whenever they have difficulty in following the same.

9.7.3 The SLDC shall be responsible for directing the overall Transmission System restoration process by coordination with all the Users and the SRLDC.

9.7.4 The Distribution & Retail Supply Licensees shall be responsible for sectionalizing the Distribution System into discrete, unconnected blocks of load. They shall advise the SLDC as to the quantum of load likely to be picked up by the Generator being synchronized.

9.7.5 The Generating Companies shall be responsible for commencing their planned Black Start procedure on the instruction of the SLDC and steadily increasing their generation according to the demand intimated by the SLDC.

9.8 Special Considerations:

9.8.1 During the process of restoration of the Transmission System, or Regional System blackout conditions, the normal standards of voltage and frequency need not be applied, and left to the discretion of the SLDC as appropriate depending on the prevailing situation.

9.8.2 The Distribution & Retail Supply Licensees shall separately identify non-essential components of essential loads, which may be kept off during System Contingencies. They shall also draw up an appropriate schedule with corresponding load blocks in each case.
The non-essential loads can be put on only when the System normalcy is restored, and as advised by the SLDC.

9.8.3 All Users shall pay special attention in carrying out the procedures to prevent secondary collapse of the System due to haste or inappropriate loading.

9.8.4 Despite the urgency of the situation, careful, prompt and complete logging of all operations and operational messages shall be ensured by all the Users to facilitate subsequent investigation into the incident and the efficiency of the restoration process. Such investigation shall be conducted promptly after the incident, and placed before the Grid Code Review Panel for appraisal in its next immediate meeting.

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SECTION-10
CROSS BOUNDARY SAFETY

10.1 Scope:
10.1.1 This Section specifies the requirements for safe working practices for maintenance of equipment associated with cross boundary operations and lays down the procedure to be followed when the work is carried out on electrical equipment connected to another User's System.

10.2 Objective:
10.2.1 The objective of this Section is to achieve an agreement on the principles of safety prescribed in the IE Rules when working across a control boundary between the Transmission Licensee and the Users.

10.3 Control Persons and their Responsibility:
10.3.1 The Transmission Licensee and all the Users shall nominate suitably authorized persons to be responsible for the coordination of safety across their boundary. These persons shall be referred to as "Control Persons".

10.4 Procedure:
10.4.1 The Transmission Licensee shall issue a list of Control Persons with their names, designations, addresses and telephone numbers, to all the Users having direct control boundary with him. This list shall be updated promptly whenever there is any change of name, designation or telephone number of any Control Person named in the list.

10.4.2 All the Users having a direct control boundary with the Transmission Licensee shall issue a similar list of their Control Persons to the Transmission Licensee. This list shall be updated promptly whenever
there is any change of name, designation or telephone number of any Control Person named in the list.

10.4.3 Whenever any work across a cross boundary is to be carried out by the User or the Transmission Licensee, the Control Person of the User or the Transmission Licensee as the case may be, who has to carryout the work, shall directly contact his counter part. Code words shall be agreed to at the time of work to ensure correct identification of both the parties. Contact between Control Persons shall normally be made by direct telephone.

10.4.4 If the work extends beyond one shift, the Control Person shall hand over charge to the relief Control Person and fully brief him on the nature of work and the code words in the operation.

10.4.5 The Control Persons shall cooperate to establish and maintain the precautions necessary to be taken for carrying out the required work in a safe manner. Both the established isolation and the established earth shall be kept in the locked positions wherever such facilities exist, and these shall be clearly identified.

10.4.6 The Control Person in charge of the work shall satisfy himself that all the safety precautions to be taken are established before commencing the work. He should issue the safety documentation to the working party to allow the work to commence.

10.4.7 After the completion of the work, the Control Person in charge of the work being carried out should satisfy himself that the safety precautions taken are no longer required, and shall make a direct contact with his counterpart Control Person and request removal of the safety precautions. The equipment shall be declared as suitable for return to service only after confirmation of removal of all the safety precautions, by direct communication, using the code word
contact between the two Control Persons, and the return of agreed safety documentation from the working party.

10.4.8 The Transmission Licensee shall develop an agreed written procedure for Cross Boundary Safety and continuously update the same.

10.4.9 Any dispute concerning Cross Boundary Safety shall be resolved at the level of the Transmission Licensee, if the Transmission Licensee is not a party. In case where the Transmission Licensee is a party, the dispute shall be referred to the KERC for resolution of the dispute.

10.5 **Special Considerations:**

10.5.1 All the Users shall comply with the agreed safety rules drawn up in accordance with IE Rules for all Cross Boundary Circuits.

10.5.2 All the equipment on Cross Boundary Circuits, which may be used for the purpose of safety coordination and establishment of isolation and earthing, shall be permanently and clearly marked with an identification number or name being unique to the particular substation. These equipments shall be regularly inspected and maintained in accordance with the manufacturer's specifications.

10.5.3 Each Control Person shall maintain a legibly written safety log, in chronological order, of all operations and messages relating to the safety coordination sent and received by him. All these safety logs shall be retained for a period of not less than ten years.

10.5.4 All the Distribution and Retail Supply Licensees connected to the Transmission System shall maintain an updated map of his System pertaining to the area fed by each Substation, and exhibit the same in the concerned area offices of the Distribution and Retail Supply Licensee.

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SECTION-11
SAFETY AND LINE CLEAR PERMITS

11.1 **Scope:**
11.1.1 This Section sets out the procedure for the record of the Line Clear Permit and sets guidelines for ensuring safety from electrical hazards to the consumers, general public and working personnel.

11.2 **Objective:**
11.2.1 The main objective of this section is to ensure safety to the working personnel of the Transmission Licensee and the Users and maintenance of proper records for the issue of Line Clear Permits for allowing the working personnel to carryout the works.

11.3 **Safety Standards:**
11.3.1 The "Safety Standard" issued separately formulates the precautions to be taken for ensuring safety to the general public, consumers of electricity and the workmen. This forms an integral part of the Grid Code and the Transmission Licensee and all the Users shall comply with this Standard.

11.3.2 The Transmission Licensee shall prepare his own "Safety Manual" for the Transmission Lines; Sub-stations based on this Standard. For the guidance of the Shift Operators, "Operation and Maintenance Manuals" for each Sub-station shall be prepared by the Licensee. These manuals shall contain all the maintenance and operation schedules based on the recommendations of the manufacturers of the various equipments installed in the Sub-station. These manuals shall be periodically reviewed based on the experience gained and replacement of equipments. A maintenance register for the equipments including the Station Batteries shall be maintained at the respective Sub-stations. These shall be updated as and when
the maintenance work is carried out and shall be periodically reviewed by the appropriate higher authority in whose control the Sub-station falls. Similar registers shall be maintained for the Transmission Lines.

11.3.3 The Operation Manual shall clearly contain the details of isolation and earthing to be provided for allowing work on the equipments. The Single Line Diagram of the station indicating the positions of various isolating devices shall be prominently displayed in the station. Charts showing the clearances from live parts (Section Clearance) for working on the isolated equipments where workmen are allowed to work shall be displayed prominently at each Sub-station. Typical charts and associated tables furnished in the "Safety Standard".

11.3.4 The "Danger" boards as required in the IE Rules and relevant Indian Standard shall be displayed at places approachable by the General Public.

11.3.5 Regular maintenance shall be carried out on all the Transmission Lines in accordance with IS 5613 and records of all these shall be maintained. Wherever possible hot line checking and replacement of failed insulators shall be made before and after monsoon.

11.3.6 All the equipments in the Receiving Stations and Substations shall be maintained in good condition as per the manufacturers' manuals and relevant Indian and/or International standards wherever available. The relays and circuit breakers shall be checked for their proper operation whenever these are taken out for maintenance purposes. The station batteries shall be maintained in good working condition by carrying out routine checks and maintenance works. The DC system provided in all these stations shall be properly
maintained with no appreciable leakage current. An on-line monitoring system for monitoring of leakage and detection of ground faults shall be provided.

11.4 *Line Clear Permit (LCP):*

11.4.1 The format setout in Annexe E, F and G shall be used. The form setout in Annexe E and designated as "Requisition for Line Clear Permit" shall be used by the requesting Safety Coordinator who is an authorized person. The form setout in Annexe F and designated as "Line Clear Return" shall be used for the return of the Line Clear Permit after the work for which the Line Clear Permit was taken is completed. The form setout in Annexe G and designated as "Check List for Line Clear Permit" shall be used at the time of issue of Line Clear Permit.
ANNEXE - E

REQISITION FOR LINE CLEAR PERMIT

Date………………………………………… Time
…………………………………………

I Sri/Srimathi ------------------ request Line Clear Permit on the following HT Line/Equipment.
HV Apparatus/Line Identification:

Details of works to be carried out:

Estimated time required for completion:

Name and Signature .................................
…………………………………………………….
(Requesting Safety Coordinator) (Incharge of the Crew)
Designation……………………………………..
………………………………………………
Date………………………………………………
………………………………………………

(FOR USE IN SUBSTATION FROM WHERE LINE CLEAR PERMIT WILL BE ISSUED)
1. Line Clear Permit issued : Yes/No
2. Number and Date of Issue (Code No.):
3. Time of Issue:
4. Time of Return:
5. Remarks: See Check List LCP - G
RECEIPT OF LCP

I have received confirmation from ………………………………………(Name of Issuing Safety Coordinator) at ………………………………………(location) that the safety precautions have been established and the instructions will not be issued at his location for their removal until his LCP-E is cancelled.

Name and Signature………………………………………………

(Requesting Safety Coordinator)

In charge of the Crew at ………………………………………(Time) on ………………………………………(Date)

(To be printed on the reverse of LCP-E: Checklist of Line Clear Permit)

CONDITIONS:

1. This Permit is valid only for working in the Feeder/Equipment mentioned herein and not in any other Feeder/Equipment.

2. Only authorized persons are allowed to work on Feeders/Equipments for which the permit has been issued.

3. Works as per requisition only should be carried out.

4. Before touching any part of the Feeder/Equipment the same should be Earthed at two points on either side through standard discharge rods connected with good Earths. Temporary Earths may only be removed after completion of all works and after all the men have come down from the Feeder/Equipment.

5. Work should be so planned that the Line Clear is returned before or at the time indicated. If unavoidable delay is anticipated advance information should be given to the location from where the Line Clear is issued.
6. Before return of the Line Clear, it should be ensured that all the men on line have returned and reported and all temporary earths removed. There should also be a check on the material, Tools and Plant issued for the work to ensure that nothing is left behind on the Line or Equipment.

7. Only authorized persons should return Line Clear.

8. In case the Line Clear cannot be returned in person, the same may be returned to the Line Clear Issuing Authority over Telephone by naming the CODE WORDS assigned. In case two or more different CODE WORDS are issued to the two or more persons in whose favour the permit is given, those persons must jointly return the Line Clear by naming their own CODE WORDS. The Line Clear Return will not be deemed to be accepted unless returned by all these persons.

9. The Line Clear issuing authority should go over the checklist of Line Clear Return before accepting it.

10. If Line Clear is returned over telephone, the Line Clear Return Form duly filled and signed should be sent to the Line Clear Issuing Authority by post immediately for record.
ANNEXE - F

LCP-F Number………………………………………
Dated……………………………………………

Check list of the Line Clear Permit:
1. Name of location for which line clear is issued.
2. Reference and Authority requisitioning line clear: (Indicate original LCP-E number including suffix and prefix).
3. Identity of HV Apparatus.
4. Sources from which the Line/Equipment is charged.
5. No./name of Circuit Breaker/Isolating Switch open at each of above sources.
6. Whether confirmed that the Line is disconnected at both ends.
7. Whether line is Earthed at both ends.
8. Whether the Circuit Breaker truck removed in case of indoor switchgear controlling the Feeder/Equipment for which line clear is given.
9. Whether fuses of control supply voltage of the Circuit Breaker/Isolating Switches controlling the feeder/equipment for which line clear is given are removed and kept in safe custody.
11. Name of requesting Safety Coordinator on whom LCP-E is issued.
12. Approximate Time for returning LCP-E as ascertained from the Requesting Coordinator.

Name and Signature………………………………………………………………………………
(Issuing Safety Coordinator)
Designation…………………………………………………………………………………………
LINE CLEAR PERMIT

LCP - F No. ..........................

I, Sri/Srimathi -------------(Issuing Safety Coordinator) do hereby issue Permission to Sri/Srimathi--------------- (Requesting Safety Coordinator) for carrying out works as per requisition No. ..........................date..........................
The HV Line/equipment herein described are declared safe. The permission is subject to the conditions overleaf.

Name and Signature..........................................

(Person issuing Line Clear Permit)

Designation.....................................................
ANNEXE G

Line Clear Return

LCP - G Number.............................................

Date ..........................................................

LCP-F No........... Dated..................

I Sri/Srimathi ********** hereby return the LCP no ---- for the following HT Line/Apparatus. I declare that all the crew who were sent on work have been withdrawn, temporary earth(s) removed, all repair tools and materials checked and the Feeders/Equipments mentioned below are safe to be energized.

1. HV Apparatus/Line Identification:

2. Safety Precaution no longer required:
   a. Isolation [State locations and each point of Isolation indicating means by which Isolation was achieved.]
   b. Earthing [State location at which Earthing was established and identify each point of Earthing means, which achieved Earthing.]

CHECK LIST TO BE TICKED OFF:

1. Whether all men withdrawn: Yes
2. Whether all temporary Earth removed: Yes
3. Whether materials, Tools and Plant used in the work have been checked: Yes

4. Code Number (If used when Line Clear is returned over phone)

Name and Signature..................................................

      (Requesting Safety Coordinator)

Designation.........................................................

Incharge of the Crew ---------------------

      (Designation)
SECTION-12
COMMUNICATION AND DATA ACQUISITION

12.1 Scope:
12.1.1 This Section specifies the minimum requirements of Communication and Data Acquisition to be provided by each User at interconnection points and cross boundary circuits.

12.2 Objective:
12.2.1 The objective of this Section is to define the minimum acceptable Communication and Data Acquisition requirements to enable the Transmission Licensee to manage the Transmission System in a safe and economic manner consistent with the requirements of his Licence.

12.3 Supervisory Control and Data Acquisition (SCADA):
12.3.1 The Transmission Licensee shall install and make operative an operational metering data collection system under SCADA for storage, display and processing of operational metering data. All the Users shall make available outputs of their respective operational meters to the SCADA interface equipment.
12.3.2 The data collection, storage and display centre shall be the State Load Despatch Centre (SLDC) at Bangalore.

12.4 Communication:
12.4.1 Independent dedicated communication links for voice communications, written communications and Data Acquisition shall be installed by the Transmission Licensee between all the Power Stations, Receiving Stations, Sub-stations and SLDC. In addition similar links between adjacent Transmission System Sub-stations shall also be established.
12.4.2 The communication shall be available by direct dialing of discrete numbers and also through Hot Line by just lifting of telephone hand set. Hot-Line links shall also be established by the Transmission Licensee between all the major Power Stations, important Substations and SLDC.

12.5 **Data Acquisition:**

12.5.1 The following real time data are required by SLDC for an effective control of the Power System:

i. MW and MVAr Generated in each Power Station,

ii. MW and MVAr Drawal from the External Interconnection,

iii. MVAr and MVAr Hours Generated or absorbed in each Power Station,

iv. MVAr Imported or Exported from the External Interconnections,

v. Voltages in all the System Busbars,

vi. Frequency in the System,

vii. MW & MVAr flow in each Transmission Line.

12.5.2 The Generating Companies shall provide the necessary transducers for the transmission of the above data from their Power Stations to SLDC/SRLDC.

12.5.3 The Transmission Licensee shall similarly provide the necessary transducers for the transmission of the above data from their Receiving Stations and Substations to SLDC/SRLDC.

12.5.4 The Transmission Licensee shall establish a suitable data transfer link between SLDC and SRLDC for exchange of operational data transmission.

12.5.5 Mutually agreed procedures shall be drawn up between the Transmission Licensee and other Users outlining inter responsibility,
accountability and recording of day-to-day communications and data transmission on operational matters.

12.5.6 All the additional data such as breaker/switch position shall be transmitted on "if change" basis. Geographical Positioning Systems (GPS) shall be used for time stamping of the trip information at the respective stations.

12.5.7 At all the 400 KV Lines and important 220 KV Lines, disturbance recorders shall be installed and the recorder data shall be made available at SLDC for post event analysis of the disturbances.

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SECTION-13
OPERATIONAL EVENT AND INCIDENT/ACCIDENT REPORTING

13.1 **Scope:**
13.1.1 This Section covers the details of requirement for the exchange of information relating to Operations and/or Events on the total System including the Southern Grid which have or may have an operational effect on:
   a) The Karnataka Power Grid in case of an Operation and/or Event occurring on a User System,
   b) A User System in the case of an Operation and/or Event occurring in the Transmission System.

13.1.2 The procedure for issue of warnings in the Event of a risk of serious and widespread disturbance on the whole or part of the Karnataka State Power Grid is set out in this Section.

13.2 **Objective:**
13.2.1 The objective of this Section is to define the incidents to be reported, the reporting route to be followed and the information to be exchanged between Users to ensure a consistent approach to the reporting of incidents and accidents on the Transmission System. These information are required to identify the potential impact of an Operation and/or Event and assess the possible risk arising from it, so that appropriate action is taken by the concerned to maintain the integrity of the Transmission System. The action to be taken arising from the exchange of this information depends on the circumstances and details for each case and does not fall within the purview of this Section.
13.3 **Reportable Incidents:**

13.3.1 All Events in the Transmission System having an operational effect on the User's System shall be notified by the Transmission Licensee to SLDC and the Users, whose systems are affected.

13.3.2 All Events on the User's System having an operational effect on the Transmission System shall be notified by the User to the Transmission Licensee and SLDC who in turn shall notify the other Users on whose System the Event may have an operational effect.

13.3.3 Typical examples of reportable incidents that could affect the Transmission System are as follows:

i. Exceptionally high/low voltage or frequency,

ii. Serious equipment problem i.e. major circuit breaker, transformer, busbar fault,

iii. Major problem in the Generating Unit,

iv. Tripping of ICT, Transmission Line or Capacitor Bank,

v. Major Fire incident,

vi. Major protection failure,

vii. Over loading of Equipment or Transmission Line which may result in hazard to the personnel,

viii. Activation of any alarm or indication of abnormal operating condition,

ix. Adverse climatic conditions being experienced or forecast,

x. Breakdown, or faults, or temporary changes in the capabilities of Plant and/or apparatus,

xi. Inpending risks of protection operation,

xii. Loss of load,

xiii. Accidents,

xiv. Excessive drawal deviations,
Minor equipment alarms.
The last two reportable incidents are typical examples of those of lesser consequences, but still affect the Transmission System and can be reasonably classified as minor. They require corrective action but do not warrant management reporting until a later, more reasonable time.

13.3.4 The examples indicated in the above clause 12.3.3 are only illustrative and in no way limit the general requirements to be reported.

13.4 Reporting Procedure:

13.4.1 All reportable incidents occurring in lines and equipments of 11 kV and above at the Grid Sub-stations shall promptly be reported orally by the User whose equipment has experienced the incident to all other significantly affected Users and SLDC. The reporting User should submit a written confirmation to SLDC within one hour of such oral report. If the reporting incident is of major nature, the written report may be submitted within two hours duly followed by a comprehensive report within 48 hours of the submission of the initial written report. In other cases, the reporting User shall submit a report within five working days to SLDC.

13.4.2 The SLDC shall call for a report from any User on any reportable incident affecting other Users and in case such User whose equipment might have been a source of the reportable incident does not report the same. However this shall not relieve any User from the obligation to report Events in accordance with IE Rules. The format for such a report shall be as per the approval of the Grid Code Review Panel and typically contain the following:

i. Location of the incident,
ii. Date and time of the incident,
iii. Plant or Equipment involved,
iv. Supplies interrupted and the duration wherever applicable,
v. Amount of Generation lost, wherever applicable,
vi. System Parameters before and after the incident,
(Voltage, Frequency, Flows, Generation, etc.)
vii. Network configuration before the incident,
iii. Relay indications and performance of protection,
ix. Brief description of the incident,
x. Estimated time of return to service,
xii. Any other relevant information,
ixi. Recommendations for future improvement,
ixii. Name of originator.

13.4.3 The report shall contain sufficient detail to describe the Event to enable the recipient to assess the implications and risks arising out of the same. The cause need not be included in the report but the recipient may ask for clarifications wherever necessary and it is obligatory that the reporting User shall put his best efforts and provide all the necessary and reasonable information.

13.4.4 In case of a request by either party the oral report shall be written down by the sender and dictated by way of a telephone message or sent by Fax/e-mail to the recipient. In case of an emergency the report can be given only orally and followed by written confirmation.

13.4.5 The maximum time limit allowed for oral report of the Event is fifteen minutes from the time of the occurrence of the Event.
13.5 **Significant Events:**

13.5.1 Significant event includes such Events having an operational effect e.g.

i. Tripping of Plant and/or Apparatus manually or automatically,

ii. Voltage outside statutory limits,

iii. System frequency outside statutory limits,

iv. System instability, or

v. System overloads.

13.5.2 Wherever a User reports an Event, which the SLDC or the Transmission Licensee considers to have had a significant effect on the Transmission System, the Transmission Licensee may require the User to report that Event in writing within one day.

13.5.3 Wherever the Transmission Licensee notifies SLDC and a User of any Event which the User or SLDC considers to have had a significant effect on the Users’ System, the User may require the Transmission Licensee to report that Event in writing within one day.

13.6 **Warnings:**

13.6.1 An oral warning shall be issued by SLDC and confirmed in writing as well, to the Transmission Licensee and the Users, who may be affected when SLDC knows that there is a risk of widespread and serious disturbance to the whole, or part of, the total System.

13.6.2 Provided that sufficient time is available, the warning shall contain such information, as the SLDC considers reasonable, to explain the nature, extent of the anticipated disturbance, to the User and the Transmission Licensee, provided that such information is available to SLDC.

13.6.3 Each User and the Transmission Licensee, on receipt of such a warning, shall take necessary steps to warn its operational staff and
maintain its Plant and Apparatus in the condition in which it is best able to withstand the anticipated disturbance for the duration of the warning.

13.6.4 Scheduling and Despatch may be affected during the period covered by such a warning.

13.7 Loss of communication with the SLDC:

13.7.1 In the event of loss of communication with SLDC the provision made as above shall not apply but instead the following provision shall apply:

Each Power Station shall continue to operate in accordance with the last Despatch instruction issued by SLDC, but shall use all reasonable endeavors to maintain the System frequency at the target of 50 Hz, plus or minus 0.5 Hz by monitoring frequency until such time the new Despatch instructions are received from SLDC.

13.8 Major Failure:

13.8.1 Whenever a major failure takes place, the Transmission Licensee and other Users shall cooperate and inquire and establish the cause of such failure and produce appropriate recommendations. The Transmission Licensee shall submit the inquiry report to the Grid Code Review Panel and submit the report with the recommendations of the Panel to KERC within two months of the incident.

13.9 Accident Reporting:

13.9.1 Reporting of accidents shall be in accordance with the IE Rules, 1956, Rule 44-A in both fatal and non-fatal accidents. The report shall be sent to the Chief Electrical Inspector to the Government of Karnataka in the prescribed form.

***
SECTION-14
DATA REGISTRATION

14.1 Scope:
14.1.1 This Section specifies a list of all the data required by the Transmission Licensee, which is to be provided by the Users, and the data required by the Users to be provided by the Transmission Licensee at the required time specified in the various Sections of the Grid Code. The corresponding Sections of the Grid Code contain the obligation to submit the data and define the times at which the data is to be supplied by the Users.

14.2 Objective:
14.2.1 The objective of this Section is to list all the data and the corresponding Sections of the Grid Code to be provided by the Users to the Transmission Licensee and vice versa.

14.3 Responsibility:
14.3.1 All the Users are responsible for submitting the up-to-date data in accordance with the provisions of the Grid Code. All the Users shall provide the Transmission Licensee, the names, addresses and the telephone numbers of the persons responsible for sending the data. The Transmission Licensee shall inform all the Users the names, addresses and telephone numbers of the persons responsible for receiving the data.

14.3.2 The Transmission Licensee shall provide up-to-date data to Users as provided in the relevant Sections of the Grid Code.

14.3.3 Responsibility for the correctness of these data rests with the concerned Users providing the data.
14.4 **List of Data to be Registered:**

14.4.1 The following data are required to be furnished by the Generating Companies to the Transmission Licensee:

1. Planning Data Requirements - Generation: As per Annexe A - Part I - of Section - 4.
2. Operation Planning Data pertaining to the Power Stations - As per Annexe D of Section - 6.
3. Generator availability notices - As per Annexe E of Section - 7.
4. System Data pertaining to the Power Stations - As per Annexe of "Transmission System Management and Operating Standards".

14.4.2 The following data are required to be furnished by the Distribution Companies to the Transmission Licensee:

1. Planning Data Requirements - Distribution: As per Annexe A - Part II - of Section - 4.
2. Operation Planning Data pertaining to Distribution - As per Annexe D of Section - 6.

14.4.3 The following data are required to be furnished by the Transmission Licensee to the concerned:

1. Planning Data Requirements - Transmission System - As per Annexe B of Section - 4.
2. Site Responsibility Schedule - As per Annexe C of Section - 5.

14.5 **Methods of submission of Data:**

14.5.1 The data schedules are structured to serve as standard formats for data submission and these formats shall be used for written data submission. Wherever standard data formats are not given, these should be developed by SLDC in consultation with the Users.
14.5.2 All the data to be submitted to the Transmission Licensee or to such other department and/or address as the Transmission Licensee may from time to time notify to Users. The name of the person who submits each schedule of data shall be indicated.

14.5.3 Wherever a computer data link exists between the User and SLDC /Transmission Licensee, data may be submitted through this link. The data shall be in the same format as specified for paper transmission except for electronic encoding for which some other format may be more appropriate. The User shall specify the method to be used in consultation with SLDC/Transmission Licensee and resolve issues such as protocols, transmission speeds etc., at the time of transmission.

14.6 **Changes in User's Data:**

14.6.1 Whenever the User becomes aware of the change to any items of the data registered under License, the User must promptly notify the Transmission Licensee of the changes. The Transmission Licensee on receipt of the changes shall promptly correct the database accordingly. This shall also apply to any data compiled by the Transmission Licensee regarding his own System.

14.7 **Data not Supplied:**

14.7.1 All the Users are obliged to supply the data referred to in the individual Sections of the Grid Code and listed in clause 14.4. In case any data is missing and not supplied by the User, the Transmission Licensee may act reasonably. If and when necessary, he may estimate such data depending upon the urgency of the situation. Similarly in case any data is missing and not supplied by the Transmission Licensee, the concerned User may, act reasonably. If and when necessary, he may estimate such data depending
upon the urgency of the situation. Such estimates, in each case, shall be based upon the corresponding data for similar Plant or Apparatus, or upon such other information, the User or the Transmission Licensee, as the case may be, deems appropriate.

14.8 **Special Considerations:**

14.8.1 The Transmission Licensee or any User may at any time make reasonable request for extra data as necessary.

***
KARNATAKA ELECTRICITY REGULATORY COMMISSION

POM CODE 1

POWER GENERATION PLANNING AND SECURITY STANDARD

POM CODE 2

POWER GENERATION MANAGEMENT AND OPERATING STANDARD

POM CODE-3

TRANSMISSION SYSTEM PLANNING AND SECURITY STANDARD

POM CODE 4

TRANSMISSION SYSTEM MANAGEMENT AND OPERATING STANDARD
1.0 OBJECTIVE

The Power Generation Planning and Security Standard has been prepared pursuant to Section 33 of the Karnataka Electricity Reform Act, 1999 and Part III Section 16 of the Karnataka Electricity Regulatory Commission (Licensing) Regulations, 2000.

2.0 SCOPE

2.1 This Standard frames the guidelines for the long, medium and short term planning strategy for a least cost planning to serve the demand of electricity by consumers in the state at the specified level of voltage, frequency and reliability. This standard comprising the following sections formulates the procedure for planning future additions to generating capacity in the State:

(a) Load forecast.
(b) Planning criteria.
(c) Estimation of peaking capacity.
(d) Estimation of energy availability.
(e) Generation plant norms for planning purposes.
(f) Economic parameters.
(g) Plant economic life.
(h) Cost of Unserved energy.
(i) Evaluation of planning studies.
(j) Power supply security standards.
(k) Capacity reserve.
2.2 The definitions of several terminologies used in these standards as well as in other standards are covered in the "Grid Code".

3.0 LOAD FORECAST:

3.1 Power Supply Planning starts with a forecast of anticipated future load demand and energy requirements prepared pursuant to condition 221(i) of Karnataka Electricity Regulatory Commission (Licensing) Regulation, 2000. The load demand forecasts shall be used to determine the capacity of generation, transmission and distribution systems and energy forecasts shall be used to determine the type of generation facilities required.

3.2 The forecasting of load demand and energy shall be done as follows:
   (a) Long term forecasting connected with load growth, supply and demand side management resources for periods ranging from 5 to 10 years or ahead.
   (b) Medium term forecasting covering a period of 2 to 5 years.
   (c) Short term forecasting connected with seasonal / weather variations in a year, weekly or daily load forecast, etc.

3.3 The forecasting of peak load demand and energy requirements shall be done by the various Distribution & Retail Supply Licensees in their respective areas of supply for each category of loads for each of the succeeding ten years of the planning period. The Distribution & Retail Supply Licensees shall submit such forecasts annually by 10th day of April each year (as detailed in the "Grid Code") to the Transmission Licensee along with data, methodology and assumptions on which the forecasts are based.

3.4 The Transmission Licensee shall integrate the load forecasts submitted by each of the Distribution & Retail Supply Licensees and determine
the long-term load forecasts for ten years for the State. The Transmission Licensee may also review the methodology and assumptions used by the Distribution & Retail Supply Licensees in making the load forecast.

3.5 The overall load forecast shall be used to determine the capacity of generation, transmission and distribution systems and energy forecasts to determine the type of generation plants required (i.e., peaking, intermediate or base load units). Peak power requirements decide the Utility's investment in generation and the resultant transmission capacity additions.

3.6 Long term (10 years) forecasts are used for:
   i. Reinforcement planning of generation, transmission and distribution systems,
   ii. Establishing future fuel requirement,
   iii. Examining the availability of natural fuel and water resources,
   iv. Development of trained human power.

3.7 Mid term forecasts are aimed at determining yearly or monthly peak, minimum load and energy requirements for one to five years for the purpose of:
   i. Maintenance scheduling of generation and transmission equipment,
   ii. Scheduling of captive power plants,
   iii. Scheduling of multi-purpose hydroelectric power plants for irrigation, flood control, cooling water requirements etc., apart from generation,
iv. Power exchange contracts with neighbouring utilities and interchange schedules,

v. Annual planning and budgeting for fuel requirements and other operational requirements.

3.8 Short-term forecasts on daily, weekly and monthly basis are required for the following purpose of

i. Unit commitment and economic despatch calculations,

ii. Maintenance scheduling updates,

iii. Assessing load flows,

iv. Spinning reserve calculations,

v. Short-term interchange schedules with neighbouring systems,

vi. System security analysis

vii. Load management scheduling,

viii. Optimization of fuel storage.

3.9 The planning process shall take into account the existing generation capacity, allocation from central sector generation and other generation to evolve the net additional requirement of power over the years of the planning period. The planning process shall consider an extended study period of 10 years beyond the base period of 10 years to smoothen out the “End effects” due to different types and capacities of generating plants at the end of base period.

4.0 PLANNING CRITERIA

4.1 Least Cost Planning: - Least Cost Planning shall be done with a planning strategy to provide reliable supply of power at the lowest
possible overall cost considering both supply side and demand side options.

The various options that are applicable at the time of planning as found economical and feasible, shall be considered.

Some of the typical options are listed below:

<table>
<thead>
<tr>
<th>Supply Side Options</th>
<th>Demand Side Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Conventional plants such as coal, thermal, nuclear.</td>
<td>1. Load management.</td>
</tr>
<tr>
<td>2. Combined cycle combustion gas turbines.</td>
<td>2. Time of the day metering.</td>
</tr>
<tr>
<td>3. Large hydro.</td>
<td>3. Achieving end use energy efficiency by use of more efficient consumer appliances/motors.</td>
</tr>
<tr>
<td>5. Captive power generation plants feeding surplus energy to the Grid.</td>
<td>5. Improving the load power factor.</td>
</tr>
<tr>
<td>7. Uprating and modernizing of existing power plants.</td>
<td></td>
</tr>
<tr>
<td>9. Improving power station efficiency.</td>
<td></td>
</tr>
<tr>
<td>10. Out sourcing of power from other agencies and strengthening of inter-regional power grid.</td>
<td></td>
</tr>
</tbody>
</table>

4.2 The process of planning shall be such that the same should meet the needs of consumers' energy requirement at the lowest possible cost, should be environmentally benign, and acceptable to the
public. For an investment to be at the least possible cost, the lifetime costs shall be considered. These shall include capital cost, interest on capital, fuel costs, and operational and maintenance costs.

4.3 Project evaluation:
For the purpose of evaluation, all options, whether supply or demand, should be assessed in a comparable and consistent manner. During such evaluation, environmental costs shall also be considered. The net present value of the revenue requirements for a chosen resource option should be calculated for the complete life cycle of the option.

4.4 Determination of the type of Generation Plant Required
The anticipated load curve is drawn and the area below the curve is filled up by available generation by suitable scheduling. The generation facilities are classified as hydro, thermal, nuclear, and gas turbines/diesel electric and others. The hydro stations are further categorized as follows:
1. Run-of-the-river: storage fills in about two hours.
2. Pondage: Storage fills in 2 – 400 hours.
3. Storage: Storage fills in over 400 hours.

Run of the river, nuclear and low cost thermal plants shall preferably be base load stations, and thus fill the lower regions of the area under the load curve. The storage hydro stations shall be used for peaking purposes in the upper region of the curve. The intermediate portion of the load curve shall constitute high cost thermal and pondage type hydro stations. If peaking requirements are still not met, gas turbines and/or diesel electric power stations shall be planned.
5.0 **ESTIMATION OF PEAKING CAPACITY**

5.1 **Peaking availability (existing stations)**

The peaking availability of the existing hydro-electric power stations, thermal power stations and diesel electric power stations furnished by the power companies in the state and the allocated share of the central sector power stations shall form the basis of evaluating the existing peaking availability.

5.2 **Peaking capability of new generating stations:**

The peaking availability of generating units shall be estimated on the basis of the norms indicated in the following clauses:

5.2.1 **Norms for peaking capability of thermal stations and gas based power stations:**

(a) The peaking capability of thermal generating units can be computed as below:

<table>
<thead>
<tr>
<th>Unit Capacity (MW)</th>
<th>OUTAGE RATES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Planned (PMR)</td>
</tr>
<tr>
<td>200 MW &amp; Above</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Note: CAF = 1 - (PMR + FOR + POR)  
PCF = CAF - CAF x AC

Where CAF - Capacity availability factor
   PCF - Plant capacity factor
   PMR - Planned Maintenance Rate
   FOR - Forced Outage Rate
   POR - Partial Outage Rate
   AC - Auxiliary consumption as per generating plant norms.
(b) Peaking capability of gas stations can be computed as below:
The gas-based power stations are grouped into two categories namely base load stations and peak load stations. The base load stations are normally combined cycle gas turbine power plant (CCCT), which have Gas Turbine units and steam turbine units. The peak load stations are open cycle gas turbine plants, which are generally used for meeting peak load, for about 8 hours in a day, at 80% of their rated capacity.

For combined cycle gas based power station, the peaking capability would be as given below:

<table>
<thead>
<tr>
<th>Unit</th>
<th>Capacity (MW)</th>
<th>OUTAGE RATES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Planned (PMR)</td>
</tr>
<tr>
<td>Gas Turbine units</td>
<td>0.15</td>
<td>0.10</td>
</tr>
<tr>
<td>Steam Turbine units</td>
<td>0.15</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Note:  
CAF = 1 - (PMR + FOR + POR)  
PCF = CAF - CAF x AC

5.2.2 Auxiliary consumption for thermal and gas based power stations:
The following auxiliary consumption figures for various types of power plants shall be considered for determining peaking capacity.

(a) Thermal power plants:
(i) Normative auxiliary consumption:
<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Conventional steam generator with motor driven boiler feed pumps</th>
<th>Auxiliary Energy consumption in Percentage for once through system of cooling</th>
<th>With closed cycle cooling using wet cooling Tower</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Domestic run of mine coal/Lignite</td>
<td>8.5</td>
<td>9.0</td>
</tr>
<tr>
<td>(ii)</td>
<td>Domestic beneficiated coal</td>
<td>8.0</td>
<td>8.5</td>
</tr>
<tr>
<td>(iii)</td>
<td>Imported beneficiated coal / Petroleum coke</td>
<td>7.5</td>
<td>8.0</td>
</tr>
<tr>
<td>(iv)</td>
<td>Corex gas</td>
<td>6.5</td>
<td>7.0</td>
</tr>
</tbody>
</table>

Note: The auxiliary energy consumption of generating stations with steam driven boiler feed pumps shall be reduced by 1.5%

(ii) Additional auxiliary consumption for flue gas desulphurization plants:

<table>
<thead>
<tr>
<th>Post combustion type for Conventional steam generator</th>
<th>Maximum additional Auxiliary consumption (percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Wet lime stone process</td>
<td>1.5</td>
</tr>
<tr>
<td>(ii) Spray dryer process</td>
<td>1.0</td>
</tr>
</tbody>
</table>

The auxiliary consumption of the generating station with circulating fluidized bed combustion steam generators at the rated capacity with electric motor driven boiler feed pumps shall not exceed the following values:

<table>
<thead>
<tr>
<th></th>
<th>With once through water cooling</th>
<th>With closed cycle cooling using wet cooling tower</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) High sulphur coals (Sulphur content &gt;1.0%)</td>
<td>10.5%</td>
<td>11.0%</td>
</tr>
<tr>
<td>(ii) Domestic coal washery rejects</td>
<td>10.5%</td>
<td>11.0%</td>
</tr>
<tr>
<td>Imported beneficiated</td>
<td>9.5%</td>
<td>10.0%</td>
</tr>
</tbody>
</table>
coal Petroleum coke/Vacuum Residue

(iii) Multiplying factors for auxiliary consumption for part load operations:

<table>
<thead>
<tr>
<th>Daily plant load factor</th>
<th>Multiplying factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>1.00</td>
</tr>
<tr>
<td>80%</td>
<td>1.08</td>
</tr>
<tr>
<td>60%</td>
<td>1.20</td>
</tr>
<tr>
<td>50%</td>
<td>1.30</td>
</tr>
</tbody>
</table>

(b) Combined cycle combustion turbine generating station:

(1) Combined cycle operation

<table>
<thead>
<tr>
<th>(a) Natural gas/LNG</th>
<th>Auxiliary energy consumption (%) with once through water cooling System</th>
<th>With wet cooling Tower system</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Without water/steam injection</td>
<td>2.50</td>
<td>2.75</td>
</tr>
<tr>
<td>ii) With water/steam injection</td>
<td>2.60</td>
<td>2.85</td>
</tr>
<tr>
<td>b) Naptha/NGL (with water/steam injection)</td>
<td>2.75</td>
<td>3.00</td>
</tr>
</tbody>
</table>

(2) Simple cycle operation

<table>
<thead>
<tr>
<th>(a) Natural gas/LNG</th>
<th>Auxiliary consumption percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Without water injection</td>
<td>1.25</td>
</tr>
<tr>
<td>ii) With water injection</td>
<td>1.35</td>
</tr>
<tr>
<td>(b) Naptha/NGL with water injection</td>
<td>1.50</td>
</tr>
</tbody>
</table>
Diesel electric generating station

<table>
<thead>
<tr>
<th>Type of diesel engine</th>
<th>Auxiliary consumption percentage:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With radiator cooling</td>
</tr>
<tr>
<td>a) Medium speed four stroke</td>
<td>4.50</td>
</tr>
<tr>
<td>b) Low speed two stroke</td>
<td>3.50</td>
</tr>
</tbody>
</table>

5.2.3. **Norms for peaking capability of hydro stations:**

Peaking capability of hydroelectric power stations can be computed as follows:

- Capital maintenance factor (CM) = 0.082
- Forced outage rate factor (FOR) = 0.045
- Auxiliary consumption factor (AC) = 0.01
- Capacity availability factor (CAF) = \[1-(CM+FOR)\] = 0.873
- Peaking capability factor (PCF) = \[CAF - CAF \times AC\] = 0.864

Seasonal hydro stations and mini hydel plants shall not be considered for peaking assistance.

6.0. **Generation Plant Norms: (Guide Lines for planning purposes only)**

6.1 Annual plant load factor:

- i) Thermal power station --- Not less than 0.75
- ii) Combined cycle combustion turbine plant --- Not less than 0.75
- iii) Diesel engine generating station --- Not less than 0.75
- iv) Hydro --- Not less than 0.75

6.2 Gross heat rate of a generating station:

6.2.1. **Thermal Plant:**

1. Steam Turbine generator cycle:

<table>
<thead>
<tr>
<th>Steam Turbine Nominal steam</th>
<th>Gross heat rate Kcal/kWh at loading of</th>
</tr>
</thead>
<tbody>
<tr>
<td>parameter</td>
<td>100%</td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
</tr>
<tr>
<td>i) 170 Kg/cm²(abs)/535°C/535°C</td>
<td>2000</td>
</tr>
<tr>
<td>ii 150 Kg/cm²(abs)/535°C/535°C</td>
<td>2040</td>
</tr>
<tr>
<td>ii 130 Kg/cm²(abs)/535°C/535°C</td>
<td>2080</td>
</tr>
</tbody>
</table>

Note: The above figures are for TG cycle with electric motor driven boiler feed pumps. For TG cycle with steam driven boiler feed pumps the gross heat rate shall be increased by 40 Kcal/kWh.

6.2.2. Steam generator efficiency:

With coal or lignite or petroleum coke or vacuum residue fuels:

Formula:

Steam generator efficiency = 92.5 - \[\frac{50A + 630(M+9H)}{GCV}\]

Where the steam generator efficiency is based on GCV (Gross Calorific Value) in percent on as fired basis,

'A' - Percentage ash content in fuel in 'as fired' basis
'M' - Percentage moisture content in fuel in 'as fired' basis
'H' - Percentage hydrogen content in fuel in 'as fired' basis

The 'GCV' value 'as received' basis shall be reduced by 100 kcal/kg and the value of 'M' increased by 1% to take into account heat lost between coal 'as received' and 'as fired' basis. The values of 'GCV', 'A', 'M', and 'H' are the weighted average of all the consignments received during the month.

Steam generator efficiency based on GCV with 'Corex gas' from steel industry shall not be less than 87.5%. Where a combination of fuels is used, the steam generator efficiency shall be the weighted average figures based on the percentage of the fuels used.

6.2.3 Gross heat rate (GHR) for a combined cycle combustion turbine (CCCT) generating station:

i) Combined cycle operation:
For a generating station using Natural gas/ Liquefied natural gas (LNG) as fuel at standard reference conditions as per latest versions of ISO - 2314 and ISO - 3977:

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Categorization based on ISO base rating of combustion turbine (in simple cycle mode with natural gas/LNG as fuel in the CCCT Block.)</th>
<th>Gross heat rate of CCCT generating station in Kcal/kWh at loading of:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>i)</td>
<td>50 MW and less</td>
<td>1800</td>
</tr>
<tr>
<td>ii)</td>
<td>More than 50 MW and less than 200 MW</td>
<td>1680</td>
</tr>
<tr>
<td>iii)</td>
<td>200 MW and above</td>
<td>1580</td>
</tr>
</tbody>
</table>

Note:

1. In case of CCCT generating stations using Naptha/Natural Gas Liquids (NGL), the above figures shall be multiplied by 1.02.

2. In case of CCCT generating stations using conventional combustor (other than dry low NOₓ control, Gross heat rate shall be increased as under due to heat rate degradation:

<table>
<thead>
<tr>
<th>FUEL</th>
<th>Natural gas/LNG</th>
<th>Naptha/NGL</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOₓ emission level</td>
<td>50 PPM</td>
<td>100 PPM</td>
</tr>
<tr>
<td>Maximum heat rate degradation in Kcal/kWh, with</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Water injection</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>ii) Steam injection</td>
<td>75</td>
<td>35</td>
</tr>
</tbody>
</table>

a. In case NOₓ emission levels stipulated in environmental clearance are different from the above values, heat rate degradation applicable shall be in proportion of the ratio of above NOₓ levels to the levels stipulated in environmental clearance.

b. If dry low NOₓ combustors are used in conjunction with water/steam injection, corresponding adjustment in heat rate shall be based on manufacturer's guarantees.
c. Gross heat rate for any loading between any two specified adjacent loading shall be interpolated on pro-rata basis.

ii) Simple Cycle Operation:-
Fuel - Natural gas /LNG

At standard reference conditions as per the latest ISO 2314:

| Categorization based on ISO based rating of combustion turbine in simple cycle mode: | Gross heat rate in Kcal/kWh at loading of: |
|---|---|---|
| | 100% | 80% | 60% |
| 1. 50 MW and less | 2800 | 2950 | 3175 |
| 2. More than 50 MW and less than 200 MW | 2600 | 2750 | 2975 |
| 3. 200 MW and above | 2400 | 2550 | 2775 |

Note:
For units using Naptha/NGL the above figures shall be multiplied by 1.01

In case of unit using conventional combustor (other than dry low NOx) and water injection for NOX Control GHR shall be increased as under:

<table>
<thead>
<tr>
<th>FUEL</th>
<th>Natural as/LNG</th>
<th>Naptha/NGL</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx Emission level</td>
<td>50 PPM</td>
<td>100PPM</td>
</tr>
<tr>
<td>Maximum heat rate degradation in Kcal/kWh with water injection</td>
<td>70</td>
<td>50</td>
</tr>
</tbody>
</table>

In case different NOx emission levels are stipulated in environmental clearance the heat rate degradation applicable shall be changed in proportion of the ratio of the above stated NOx levels to the NOx levels stipulated in the environmental clearance.

If dry low NOx combustors are used in conjunction with water injection, corresponding adjustment in heat rate shall be mutually agreed based on manufacturer's guarantees.
6.2.4 Gross heat rate for Diesel Electric Power Stations:

Gross heat rate at standard reference conditions as per latest version of ISO-3046 shall be

(a) the following values:

<table>
<thead>
<tr>
<th>Type of diesel engine</th>
<th>GHR in Kcal/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Medium speed four stroke</td>
<td>2000</td>
</tr>
<tr>
<td>ii) Low speed two stroke</td>
<td>1900</td>
</tr>
</tbody>
</table>

OR

(b) Guaranteed values corresponding to MCR **whichever is less.**

Gross heat rate indicated above shall remain applicable for various loading conditions of the station. Generally heat rate of diesel generating unit does not vary significantly between 70% and 100%

6.2.5 Specific secondary fuel oil consumption:

a) Steam power station:

The specific secondary fuel oil consumption for the purpose of start up, shut down and flame stabilization shall not exceed the following values:

<table>
<thead>
<tr>
<th>Type of fuel</th>
<th>Consumption in ML/gross kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) All types of coals, petroleum coke and vacuum residue</td>
<td>1.0</td>
</tr>
<tr>
<td>b) Lignite</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Note: While calculating the consumption of primary fuel, the heat credit for the secondary fuel consumption at the above rates shall be given.
6.2.6 Specific reagent consumption for flue gas desulphurization system:

a) In-combustion system: - For circulating fluidized bed combustion type of steam generators shall be:

i) Guaranteed specific Reagent consumption, or

ii) Values, as per the following formula, whichever is less.

<table>
<thead>
<tr>
<th>FUEL</th>
<th>Reagent</th>
<th>Specific reagent consumption Kg/Kg of fuel consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Sulphur coal/Lignite</td>
<td>Lime</td>
<td>[6.25/P] x S</td>
</tr>
<tr>
<td>Pet coke/vacuum residue</td>
<td>Lime</td>
<td>[7.8/P] x S</td>
</tr>
</tbody>
</table>

Where \( S \) is the percentage Sulphur content in primary fuel.

\( P \) is percentage purity of reagent.

b) Post combustion system: -

Specific reagent consumption shall be

(i) Guaranteed specific reagent consumption or

(ii) Value as per the following formula whichever is less.

<table>
<thead>
<tr>
<th>Process</th>
<th>Reagent</th>
<th>( \text{SO}_2 ) Removal efficiency</th>
<th>Specific Reagent consumption Kg/Kg of fuel consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet lime stone process</td>
<td>Lime</td>
<td>90% and more</td>
<td>[3.28/P] x S</td>
</tr>
<tr>
<td>Spray dryer absorber process</td>
<td>Lime</td>
<td>70% and more but &lt;80%</td>
<td>[2.19/P] x S</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80% and more but &lt;90%</td>
<td>[2.45/P] x S</td>
</tr>
<tr>
<td></td>
<td></td>
<td>90% and more</td>
<td>2.8 x S</td>
</tr>
</tbody>
</table>

Where \( S \) - percentage Sulphur content in the fuel

\( P \) - Percentage purity of reagent.
6.2.7 **Lubricating oil consumption for diesel electric power station:**

Consumption shall not exceed the following values:

<table>
<thead>
<tr>
<th>TYPE OF DIESEL ENGINE</th>
<th>Lubricating oil (including cylinder oil) Consumption in g/KWH (Gross)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Medium speed - 4 stroke</td>
<td>1.0</td>
</tr>
<tr>
<td>b) Low speed - two stroke</td>
<td>1.2</td>
</tr>
</tbody>
</table>

7.0 **ESTIMATION OF ENERGY AVAILABILITY:**

The following plant availability shall be assumed for determining annual energy:

<table>
<thead>
<tr>
<th>Hydro stations</th>
<th>-Normative availability shall be considered at 85% Energy availability depending upon hydrology of each project.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal stations Combined cycle combustion turbine plants Diesel electric power stations</td>
<td>-Annual plant load factor shall be considered to be not less than 0.75</td>
</tr>
</tbody>
</table>

The auxiliary consumption of hydroelectric power stations shall be assumed as 1.0% of energy generated for the purpose of energy availability to the Grid.

8.0 **ECONOMIC PARAMETERS:**

The cost estimate shall reflect economic conditions as on the base year. The increase in cost over time till the project is completed shall be at the rate of inflation prevailing over the period of each expenditure and excludes taxes and duties. Discounting for calculating cumulative present cost for each scheme shall be done at an annual rate of 10%.
9.0 **PLANT ECONOMIC LIFE:**

The economic life of generating plants may be assumed as follows for the planning studies in accordance with Government of India notification made under sub-paragraph (A) of Paragraph VI of VI Schedule to Electricity Supply Act, 1948, from time to time.

<table>
<thead>
<tr>
<th>Plant type</th>
<th>Life in years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro Electric</td>
<td>35</td>
</tr>
<tr>
<td>Thermal Electric and waste heat recovery boilers/plant</td>
<td>25</td>
</tr>
<tr>
<td>Diesel Electric and Gas plants</td>
<td>15</td>
</tr>
</tbody>
</table>

10.0 **COST OF UNSERVED ENERGY:**

Value of Unserved energy (i.e. the loss to economy if a kWh of energy required by consumers can not be supplied) shall be considered in the economic analysis for the least cost generation expansion plan. Suitable pricing for such power outage costs shall be adopted from available studies applicable for Karnataka State.

11.0 **EVALUATION OF PLANNING STUDIES:**

Suitable computer programs shall be adopted to arrive at a least cost generation expansion plan.

The following guidelines are to be broadly followed in the estimation:

1. The following generation capacity addition scenarios to be considered in the context of demand forecast:
   
   (i) Mixed Hydro Thermal,
   (ii) Only Thermal,
   (iii) Only Diesel,
Mixed base/peak generation.

(2) For each of the above, determine by simulation, the timing of the new generating plants during the planning period in order to meet the Security Standards.

(3) Simulate the system operation in order to obtain the average annual energy production from each plant.

(4) Compute the cumulative present value cost incorporating the capital costs, fixed and variable operation and maintenance costs, fuel costs and Unserved energy costs, for each scenario over the planning period.

(5) Compare the present value cost of each scenario with that of the others to arrive at the least cost scenario.

(6) Calculate the long run marginal cost for the least cost scenario as follows:

(i) For each year of the plan period determine incremental cost of generation, energy requirement, energy generated, incremental net energy generated, loss of load probability in hours & unserved energy.

(ii) Reduce the incremental cost of generation to the net present value.

(iii) Long run marginal cost in Rs/kWh is = [The total net present value of incremental cost of generation (Rs.)]/[Incremental net energy generation (kWh)].

12.0 POWER GENERATION SECURITY STANDARDS:

12.1 Adequate reserve capacity shall be available to ensure sufficient generation reserve to meet the system load even if two of the largest units in the system are out of service, or to meet the non availability of adequate hydro electric generation due to poor monsoon. The peaking capacities and the energy generation capacities, availability of power plants on which the power and energy balance studies are based shall
be determined on the basis of the capacity reserve specified in the following clause 13.0.

13.0 CAPACITY RESERVE

13.1 Loss of load probability (LOLP) of 2% shall be used for planning models. This shall mean that for 2% of the year (i.e., up to 7.3 days per year) the power system may experience shortages of generation capacity.

13.2 A contingency reserve margin equal to 5% of the system peak load shall be planned to take care of fluctuations in the availability of hydro electric generation during critical period of February to June of a dry year, and to account for outage of units, power station equipment, non availability of Central Sector share in order to maintain security and integrity of system.

13.3 “Energy not served” shall be limited to 0.15% of the average annual energy.

[Explanation: - The anticipated load curve for the year shall be drawn with time on "X" axis and load on "Y" axis. The area under the curve represents the energy requirement. A suitable point on "Y" axis representing the total anticipated power generation capacity shall be marked, and a horizontal line is drawn through this point. This line cuts the load curve at several points. The area under the load curve up to this line will be the "Energy Not Served", and shall be not more than 0.15 % of the total area under the load curve up to "X" axis. The total time duration during which the energy not served falls shall not exceed 2% viz., 7.3 days in a year].
POWER GENERATION MANAGEMENT AND OPERATING STANDARD.

1.0 OBJECTIVE
The Power Generation Management and Operating Standard has been prepared pursuant to Section 33 of the Karnataka Electricity Reform Act, 1999 and Part III Section 16 of the Karnataka Electricity Regulatory Commission (Licensing) Regulations, 2000.

2.0 SCOPE
2.1 This Standard provides guidelines for operation and maintenance of power stations covering aspects of:

1) Outage planning of generating stations duly coordinating with the outage planning of transmission system and distribution systems,
2) Generation scheduling and despatch,
3) Frequency / Voltage / Reactive power management,
4) Black Start operations, maintaining spinning reserves etc., with the objective of making available quality power supply to consumers as laid down in condition 221(i) of Karnataka Regulatory Commission (Licensing) Regulations, 2000.

2.2 The definitions of several terminologies used in these standards as well as in other standards are covered in the "Grid Code".

3.0 QUALITY OF POWER SUPPLY UNDER BULK SUPPLY LICENCE:

3.1 **Frequency**: - The rated power frequency shall be 50 Hz. All the constituents shall make all possible efforts to ensure that the grid frequency remains within the 49.0 -50.5 Hz band.

3.2 **Voltage**: -The highest and lowest voltages given in the following table shall be considered for design purposes:
<table>
<thead>
<tr>
<th>AC Voltage Band</th>
<th>Nominal Voltage KV-rms.</th>
<th>Maximum KV</th>
<th>Minimum KV</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIIB</td>
<td>66</td>
<td>72.5</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>110</td>
<td>124</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>220</td>
<td>245</td>
<td>200</td>
</tr>
<tr>
<td>IIIC</td>
<td>400</td>
<td>420</td>
<td>360</td>
</tr>
</tbody>
</table>

The voltage at any point of the system under normal conditions shall not depart from the declared voltage by more than the values given below:

Band IIIB & IIIC ±12.5%.

3.3 **Harmonic content:** - The total harmonic content for various voltage levels shall not exceed the following:

i) For voltage levels between 400 V and 45 KV – 9%
ii) For voltage levels between 45 KV and 220 KV – 4%
iii) For voltage levels higher than 220 KV – 3%

4.0 **OUTAGE PLANNING**

4.1 The generating companies/Captive Power Plants (CPP) shall finalize their outage planning in coordination with the Transmission Licensee to minimize the overall outage period as detailed in the Grid Code.

4.2 Notwithstanding provision in any approved outage plan, no generating unit of a generating company or Captive power plant feeding the grid in excess of 5 MW shall be removed from service without specific release from the State Load Despatch Centre (SLDC)

4.3 Once an outage has commenced, if any delay in restoration is apprehended, SLDC shall be informed promptly together with revised estimation of restoration time.
5.0 GENERATION SCHEDULING AND DESPATCH

5.1 All generating companies shall provide ¼ hourly mw / mvar / maximum mwh availability (00.00 – 24.00 hours) of all generating units, to SLDC daily on day ahead basis by 10.00 hours.

5.2 CPPs shall forecast and provide the ¼ hourly import / export figures to sldc daily on day ahead basis by 10.00 hours.

5.3 In working out the mw / mvar / maximum ex-bus mwh, hydro power stations shall take into account their respective prevailing reservoir levels and any other restrictions on water usage and shall report the same to sldc.

5.4 In case of hydro generation complexes where irrigation is not involved and several power stations are constructed in the course of a single river, a scheme for integrated operation of the complete generation complex must be evolved for optimizing the generation in all the power stations in the complex. the forecast of generation from each of the power stations shall be done with the aid of suitable computer programs. these programs shall take into account the water flows into each of the catchment areas in addition to discharge from the upstream power stations, load demand forecasts from sldc, availability of generating units in each station etc. for the purpose of this clause, optimization shall mean, that there should not be any loss of generation due to spillage of water in any of the reservoirs, except when all the reservoirs are full, and generation has reached the maximum limit for these power stations, due to excessive inflow of water than expected.

5.5 In addition, the total ex-bus MWh, which can be actually delivered during the day, shall also be declared. The maximum demand capacity for each time block (¼ hour) hereinafter referred to as MDC and the total MWh capacity for the day including limitation on generation during any
specific period of the day as declared by the generating companies along with inputs from CPPs shall form the basis of generation scheduling.

5.6 In case of thermal stations, the declaration shall be for the capacity of the generating station (excluding units ordered closure on account of generation scheduling) to deliver ex-bus MWh for each time block of the day (¼ hour). The capacity of the generating plant hereinafter referred to as declared capacity shall form the basis of generation scheduling.

5.7 SLDC shall obtain from Southern Region Load Despatch Centre (SRLDC) the ¼ hourly MW entitlements from central generating stations by 11.00 hours on a day ahead basis.

5.8 SLDC shall produce a day ahead ¼ hourly generation schedule after consolidation of the data provided by the generating companies and SRLDC. It will take into account the ¼ hourly demand estimates and latest planned drawal schedule agreed with SRLDC.

5.9 In preparation of the schedule, SLDC shall take into account, the relative commercial costs to the Licensee for the operation of the generating units.

5.10 SLDC shall prepare the day ahead generation schedule keeping in view the following:

- Transmission system constraints from time to time.
- ¼ hourly load requirements as estimated by SLDC.
- The need to provide operating margins and reserves required to be maintained.
- The availability of generation from generating companies, central sector generating companies and CPPs together with any constraints in each case.
- Overall economy to Licensee and customers. This shall take into account the cost of power purchase from each generating company and the cost of energy loss in transmission for arriving at a
generating schedule, which results in least possible cost of power to the Licensee and customers.

- Terms and conditions in Tariff agreements with generating companies, Independent Power Producers (IPPs), & CPPs.
- Optimization of both MW/MVAR out puts from Generating Plants.

5.11 SLDC shall instruct generating companies to hold capacity reserves (spinning and / or standby) to the agreed Southern Regional Electricity Board (SREB) guidelines or as determined for local conditions.

5.12 SLDC may also require generating companies / CPPs generating MVAR within their respective capability limit to maintain station bus voltages within the specified band of maximum and minimum.

5.13 SLDC shall intimate generation schedule / import / export schedule for the following day to all generating companies / CPPs (including any generating unit not required to be run) by 16.00 hours.

5.14 Generating companies shall promptly report to SLDC. Changes of generating unit availability or capability, or any unexpected situation, which would affect its operation.

5.15 All CPPs shall similarly report regarding their export to the Transmission Licensee. SLDC shall advise users as soon as possible of any necessary rescheduling.

6.0 FREQUENCY MANAGEMENT

6.1 The Transmission Licensee/SLDC shall endeavor to run the system within the frequency band of 49.0 HZ to 50.5 HZ. Automatic load frequency relays would be one of the devices to assist to maintain frequency at 50 Hz.
6.2 The Transmission Licensee/SLDC shall be vigilant when the frequency begins to rise above 50 HZ and initiate the following measures to bring down the frequency to around 50 HZ:

- Check generation scheduling Vs generation and request concerned generating company with excess generation to conform to generation schedule.
- Advise hydro stations to reduce generation without water spillage.
- Advise coal fired thermal stations having 210 / 500 MW units to back down to “X” multiplied by the load factor (where “X” is the generation of particular units during peak hours) but not to the extent requiring oil support.
- Give appropriate instructions to other generating stations.

6.3 In case frequency rises to 50.5 HZ in spite of above measures, the Transmission Licensee shall:

- Advise diesel electric and coal fired thermal stations having 210 / 500 MW units to bring down generation to bare minimum using oil support or if necessary to shut off 210 MW units.

6.4 In case the frequency still has a raising trend even beyond 50.5 HZ, and if there is import at points of interconnections, the Transmission Licensee in consultation with SRLDC island its system from the rest of the Southern Grid.

6.5 The Transmission Licensee shall be vigilant when frequency begins to fall below 49.5 HZ and initiate the following measures to raise the frequency to approach 50 HZ:

- Check generation scheduling Vs generation and request concerned generating company with less generation to conform to generation schedule.
- Check whether there is any excess drawal at any points of interconnection by any Distribution & Retail supply Licensee.
and advise such Licensee/ Company to restrict its drawal within schedule.
- Advise hydro stations to synchronize standby machines if available.

6.6 In case the frequency still falls and reaches 49.0 HZ the SLDC shall advise the Distribution & Retail Supply Licensees to shed load manually in predetermined blocks.

6.7 In case the frequency still continues to fall and reaches 48.5 HZ, the Transmission Licensee shall in consultation with RLDC island its system from rest of SREB if there is export at points of interconnection and in the event of net import, shall contact SLDC for instructions regarding load shedding in the Southerngrid to maintain frequency and grid integrity.

7.0 VOLTAGE AND REACTIVE POWER MANAGEMENT

7.1 Generating companies shall make available to SLDC the up-to-date capability curves for all generating units indicating restrictions if any, to allow accurate system studies and effective operation of the transmission system. Cpps shall similarly furnish the net reactive capability that will be available for export / import from the transmission system.

7.2 Load flow studies shall be conducted for different conditions of operation commonly encountered. The voltages of all the node points shall have to be maintained within the specified limits. On the basis of these studies SLDC shall instruct generating companies and CPPs to maintain specified voltage levels at interconnecting points by transformer tap changing to the extent possible and use MVAR reserves in accordance with technical limits of generating units as per capability curves. Transmission system
voltage levels can also be affected by regional operation. High transient voltages generally occur during load throw off and switching operations. This should be controlled to be within specifications by adequate control strategies.

7.3 The voltage angle between the most lagging and the most leading machine terminals in a power station should be within the range of 30 - 40 degrees for a strongly coupled system. This may be achieved by controlling the active and reactive power generation in all the machines in the station to be in proportion to their rated capacities.

8.0 BLACK START OPERATIONS
8.1 Preferably all major hydro-generating stations shall have black start capability. In the event of total or partial blackout of the system and in the event of non-availability of external source for start up, one of the generating units having connection to an auxiliary transformer in the station shall be started using supply from black start generator. The procedure for such start up shall be evolved and after bringing one unit in to service, other units in the power station shall be started and brought into service to bring the station back to normalcy. Start up power supply to other power stations can be extended as per instructions of SLDC in case of necessity.

9.0 SCHEDULE OF DESPATCH
9.1 Generation Despatch
9.1.1 All generating companies shall regulate generation and CPPs regulate their export according to the daily generation schedule. All generating units, above 5 MW, other than those of CPPs, will be subject to Central despatch instructions. CPPs will be subject to these instructions to the extent of their respective exports to the Transmission Licensee. SLDC will despatch by instruction all generation and imports from CPPs according
to the ¼ hourly day ahead generation schedule, unless rescheduling is required due to unforeseen circumstances. In the absence of any despatch instructions by SLDC, generating companies and CPPs shall generate / export according to the ¼ hourly day ahead generation schedule. Despatch instruction shall be in the standard format. These instructions will recognize declared availability and other parameters, which have been made available by the generating company to SLDC. These instructions shall include time, name of the Power Station, generating units (total export in case of CPP), name of operators sending and receiving the same.

9.1.2 Despatch instructions may include:

- To switch a generator in or out of service.
- Details of reserve to be carried on a unit.
- To increase or decrease MVAR generation to maintain voltage profile.
- To begin pre-planned black start procedures.
- To hold spinning reserves if available.
- To hold generating units on standby if available.

9.2 Communication with generating companies: - Despatch instructions shall be issued by e-mail / Telephone, confirmed by exchange of names of operators sending and receiving the same and logging the same at each end. All such oral instructions shall be complied with immediately, and written confirmation shall be issued by Fax, Teleprinter or otherwise.

9.3 Action required by generating companies
9.3.1 All generating companies and CPPs shall comply promptly with despatch instructions issued by SLDC unless this action would compromise the safety of plant or personnel. The generating Company and CPPs shall promptly inform SLDC in the event of any
unforeseen difficulties in carrying out an instruction. All generating units shall have Automatic Voltage Regulators (AVR) in service. All generating units shall have the governors available and in service and must be capable of automatic increase or decrease in output within the normal declared frequency range and within their respective capability limits. Generating companies shall immediately inform SLDC by telephone of any loss or change (temporary or otherwise) of / in the operational capability of any generating unit which is synchronized to the system or which is being used to maintain system reserve. Generating companies shall inform SLDC any removal of AVR and / or governor from service with reasons. CPPs shall similarly inform any change in status affecting their ability in complying with despatch instructions. Generating companies shall not de-synchronize generating units, other than in respect of CPPs, without instruction from SLDC except on the grounds of safety to the plant and personnel, which shall be promptly reported to SLDC.

9.3.2 Generating companies and CPPs shall report any abnormal voltage and frequency related operation of generating units / feeders promptly to SLDC. Generating companies shall not synchronize generating units, other than CPPs, without instruction from SLDC.

9.3.3 Standing instructions - In the event of any emergencies the generating company may synchronize units with the grid without prior intimation in the interest of safe operation of the grid following standing instructions developed for such purpose under “contingency planning”.
9.3.4 Should a generating company fail to comply with any of the above provisions, it shall inform SLDC promptly of this failure with reasons.

10.0 Standards to be met by the Generating companies:

10.1 The Transmission licensee while contracting bulk power supply from generating companies shall specify voltage and frequency standards in the power purchase agreement with limits of variation, which the generating company has to comply with.

10.2 Thermal/nuclear generating units shall not normally run at leading power factor. However, for the purpose of charging, generating unit may be allowed to operate at leading power factor as per the respective capability curves.

10.3 The Transmission Licensee shall incorporate conditions in power purchase agreement requiring the generating companies to commit:

- Governor response during frequency transients at different load levels.
- Reactive power capability, (MVAR)
- Line charging capability.
- Economic back down level.
- Loading increment rate from back down level to maximum continuous rating (MW/Min).
- Loading decrement rate from maximum continuous rating to back down level (MW/Min).
- Pickup rates on synchronizing in MW to the extent that it does not jeopardize safety of its plant and personnel under the following conditions:
  1) Cold Start.
  2) Warm Start.
  3) Hot Start.
• Black Start capability preferably in all major hydro stations.

11.0 GENERATION RESERVE
11.1 The Transmission Licensee shall plan for necessary capacity and energy reserves in accordance with security standards. These reserves shall be allocated to the generating companies in the following manner:
   1) Contingency Reserve: On month ahead basis.
   2) Spinning Reserve: On day ahead basis.

11.2 The total minimum reserves of 5% of system Peak Load shall be achieved by making suitable allocations to specific generating stations.

12.0 MONITORING OF GENERATION
12.1 The Transmission Licensee shall provide facilities at SLDC for receiving the following real time data from generating companies:
   1) Frequency.
   2) MW output.
   3) MVAR output.
   4) MW and MVAR flow in outgoing lines.
   5) Voltage at interconnection bus.

12.2 The Transmission Licensee shall establish suitable procedure for monitoring the following parameters of a generating plant:
   1) Declared gross generation capacity.
   2) Loading rate of a unit.
   3) De-loading rate of a unit.
   4) Active and Reactive power delivery following despatch instructions.
   5) Capability of the generating plant to meet spinning reserve requirements.
TRANSMISSION SYSTEM PLANNING AND SECURITY

STANDARD

1.0 OBJECTIVE

The Transmission System Planning and Security Standard has been prepared pursuant to Section 33 of the Karnataka Electricity Reform Act, 1999 and Part III Section 16 of the Karnataka Electricity Regulatory Commission (Licensing) Regulations, 2000.

2.0 SCOPE

2.1 The Transmission System Planning and Security Standard has been prepared pursuant to condition 22-1-(i) of Karnataka Electricity Regulatory Commission – Licensing Regulations 2000. It formulates the guidelines for planning and expansion of transmission system in the State of Karnataka. The scope of this standard covers:

(a) System studies to be conducted for planning.
(b) Assessment of the system data to be maintained.
(c) Assessment of generation availability and identification of the locations of future power stations and major load centers including expansion of existing Power Stations, receiving stations and substations for planning an overall economical power system.
(d) Planning criteria.
(e) Limits of line loading.
(f) Options to be considered for strengthening of existing lines wherever economically feasible.
(g) Security conditions required for maintaining specified degree of reliability.
(h) Criteria for substation planning.
(i) Estimation of reactive power compensation required.
2.2 The definitions of several terminologies used in this standard as well as in other standards are covered in the "Grid Code".

3.0 TRANSMISSION PLANNING

3.1 The long and medium term perspective planning involves an integrated approach for evacuating power from different generating stations, irrespective of their ownership, and delivering it to the beneficiaries over an optimally designed power transmission system with reliability, security and economy. The power system in Karnataka has to be planned in such a manner, that the power received from all the power plants, the share of power from Southern grid and central sector power stations can be transmitted without constraints to different beneficiaries, as per their allocated shares, maintaining a reasonably good voltage profile, stability conditions and redundancy criteria.

3.2 The transmission planning should be developed to achieve a strong co-ordinated power system for the Southern region and ultimately a national grid, where substantial inter-regional transfers can be achieved with optimized utilization of available generation and to provide a high standard of supply to beneficiaries with acceptable degree of reliability and at reasonable cost. The criterion should be that even under the conditions of the specified outages considered in the security standards, the power flow should not be affected. The transmission planning should keep in view the long term future load growth also and the transmission lines and substations shall be so planned that the same can be upgraded when necessary in future, with minimum interruptions and modifications.
3.3 For the purpose of reducing inventory, procurement time and installation time, the Licensee shall adopt standardized designs as far as possible for transmission line towers, structures for substations, substation lighting, control room lighting and ventilation, substation earthing, standardized specification for line materials, transformers, substation equipment, cables, bus bar accessories, insulators, hardwares etc.

3.4 The possibility of providing adequate transmission interconnections within the Karnataka state grid as well as between interstate grids has to be considered wherever economically feasible considering all economic energy/capacity interchanges subject to trade off between new generation and cost of transmission. The modern Flexible AC Transmission System (FACTS) based on thyristor based controls, HVDC, fast controllable phase shifters etc., have also to be considered wherever economically feasible and/or constraints of corridor exist for construction of new transmission lines.

4.0 SYSTEM STUDIES

4.1 The loads to be supplied from various sub-stations at steady state within the limits of declared voltage and acceptable frequency of 50 Hz and the future load development has to be assessed after making a detailed study of the present conditions and a load survey. A reasonable estimate of transmission losses shall also be included to arrive at peak generation capacity. The system is to be further evolved based on the following power system studies:

- Load flow
- Optimal power flow for various conditions.
- Short Circuit
- System stability- Steady state
- System stability-transient
- Studies to determine switching/temporary over voltages
- Other studies as required.
4.2 These studies require suitable computer programs. Mathematical models of generation, transmission and load shall be prepared separately for each year of a plan period assessing probable year of commissioning of particular lines, sub-stations, additional transformers in existing sub-stations etc, based on the system network for the year in question with all the generation and load buses properly located. Inter connections with the southern grid through neighboring states at 400KV and 220KV levels shall have to be incorporated. Appropriate equivalent circuit models shall be used to take into account the fault level at the interconnection points. The interconnection buses shall be modeled by representing significant and necessary portions of the neighbouring networks to represent realistically the MW and MVA imports/exports. Studies shall be carried out both for peak load and minimum load conditions.

5.0 SYSTEM DATA

5.1 To arrive at a reasonably accurate load forecast and for conducting studies, compilation and updating of system data is absolutely necessary. The planning study should begin with the proper representation of the existing system to establish the base case and to validate the model. The results obtained for the existing system should be verified with the meter readings, logged data at the sub-stations and the state load despatch center to closely match the same. The system parameters have to be updated incorporating the correct data whenever addition or modifications have been carried out on the system either by the survey of the correct line lengths and conductor configurations or preferably by direct measurement of the line impedance values whenever and wherever possible. All the system data shall be the same for both the planning standards and operation standards. The loads shall be modeled at 220KV, 110KV and 66KV buses. The annual minimum load shall be taken
as a percentage of annual peak demand as prevailing in the base year. Wherever data is not available, the load power factor at 110/66 KV levels can be taken as 0.85 lag/0.90 lag for peak load/light load conditions for normal loads and 0.75 lag/0.85 lag for predominantly agricultural loads. Where power factor is less than the figures specified above, the respective utilities shall bring the power factor to the above limits by providing compensation at appropriate places. The norms given in the Annexure shall be followed for all other parameters for conducting system studies wherever data is not available.

6.0 GENERATION

6.1 For peak load conditions, different generation mixes of various power stations, resulting in an optimal average cost shall be determined by conducting the required number of load flow studies, or using well developed computer program packages to determine the same. For the minimum load conditions, the generator which must run shall be used in conjunction with the most economical generation. The generation despatch for the purpose of sensitivity analysis corresponding to a complete closure of a major generating station shall be worked out by increasing the generation at other stations to the extent possible keeping in view the maximum likely availability at those stations, cost of power, etc. Transmission constraints will have to be addressed properly. The transmission system being planned shall consider the adequacy of the network required to transmit power even under various outage conditions specified in the security standards. Studies shall be repeated for normal and contingency conditions as required in the security standards.
1.0 PLANNING CRITERIA

1.1 The steady state voltage limits permissible for transmission and sub-transmission voltages are as follows:

<table>
<thead>
<tr>
<th>AC Voltage Band</th>
<th>Nominal System Voltage KV-rms</th>
<th>Maximum KV- rms</th>
<th>Minimum KV- rms</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIIB</td>
<td>66</td>
<td>72.5</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>110</td>
<td>124</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>220</td>
<td>245</td>
<td>200</td>
</tr>
<tr>
<td>IIIC</td>
<td>400</td>
<td>420</td>
<td>360</td>
</tr>
</tbody>
</table>

7.2 The above limits may be exceeded only during outages of 400KV lines and in such cases it is necessary to supply dynamic VAR resources at required nodes. Under normal operations when all the system elements are healthy, under the normal tap positions of the power transformers at the sending end, the system voltages at various levels at the tail end of the lines shall be as close to the nominal voltage as possible. The tap positions may be increased or decreased at peak load or off load conditions respectively.

7.3 The system should withstand satisfactorily the outage of any 2 circuits of 66 KV or 110KV or 220KV lines or any one circuit of 400 KV lines with the voltage and frequency levels remaining within the prescribed limits. The system shall remain in synchronism even in case of a single line to ground fault or three phase fault, assuming successful clearance of fault by the protective devices.

7.4 Adequate margin shall be available, in terms of voltage and steady state oscillating stability.

8.0 LINE LOADING LIMITS

8.1 The capacity of EHV line shall be the lowest of the following:
1. **Thermal limit**: Some of the old transmission lines in the Karnataka grid are designed for a conductor temperature of 55°C. Subsequently 65°C was adopted. At present the same is raised to 75°C for ACSR conductors and 85°C for AAAC conductor. For future lines, the higher limit is recommended, even though the load on the line may be less. A suitable derating factor shall be applied for old transmission lines depending on the condition of the conductors.

2. **Sag criteria**: This depends on the actual conductor temperature and minimum required ground clearance as per I.E. rules.

3. **Stability limits**: This shall be based on the stability analysis made for each line both for steady state stability and transient stability. For planning purposes, the guidelines furnished in the Annexure may be considered in the absence of detailed computer studies.

4. **The maximum load that can be transmitted on the transmission line, within the ± 12.5% voltage regulation limits.**

### 9.0 OPTIONS FOR STRENGTHENING OF TRANSMISSION NETWORK

9.1 The following options are to be considered to evolve an optimal planning and design of transmission system.

1. Addition of lines to avoid over loading of the existing lines.
2. Next higher voltage may be considered where three or more circuits of the same voltage class are envisaged between two substations.
3. Reconductoring of old power conductors with aluminum alloy conductors on the existing supports wherever permissible.
4. Use of ‘V’ string or polymer insulators to prevent conductor swing and to increase clearances.
5. Introduction of additional panel in the tower structure suitably to increase ground clearance, wherever permissible in design, since the older lines are designed with a higher factory of safety.
6. Replacement of metal cross arms with insulated cross arms and reconductoring.
7. Reinforcing tower legs with additional steel sections wherever possible.
8. Uprating the transmission system wherever possible, to next higher voltage.
9. Application of series capacitors in the existing transmission lines to increase power transfer capability.
10. Flexible AC transmission systems (FACTS) and HVDC systems.
11. Static Var. systems to increase the capability of transmission lines.
The choice shall be based on cost, reliability and right of way requirements, energy losses, down time etc.

9.2 Only double circuit towers shall be used in all future lines up to and including 220KV. In case of transmission system associated with nuclear power stations there shall be two independent sources of power supply for the purpose of providing start up power. Further the angle between start up power sources and the NPP switchyard should be as far as possible maintained within 10 degrees.

9.3 The evacuation system for sensitive power stations viz. nuclear power stations shall be planned so as to terminate it at large load centers to facilitate islanding of power station in case of contingency.

10.0 SECURITY STANDARDS

10.1 Steady State Stability

The system shall be planned to withstand satisfactorily without any load shedding or altering the generation at power stations for at least, any one of the following outage conditions:

1. Outage of any tower in a D/C Transmission line
2. Two Circuits of 66 KV or 110KV or 220KV lines.
3. One circuit of 400KV line.
4. One interconnecting transformer.
5. One largest capacity generator.
6. One inter-connecting line with neighbouring grid.

The above contingencies shall be considered assuming a precontingency system depletion (planned outage) of another 220 KV double circuit line or 400 KV single circuit line in another corridor and not emanating from the same substation. All the generating plants shall operate within the limits as per their reactive capability
curves and the network voltage profile shall also be maintained within the specified voltage limits.

10.2 Transient Stability

The system shall be designed to maintain synchronism and system integrity under the following disturbances.

1. Outage of the largest size generator in the Southern grid or interconnection with neighbouring grids.

2. (a) A single line to ground fault on a 400KV line, single pole opening of the faulted phase (5 cycles) with unsuccessful reclosure (dead time 1 sec) followed by 3 pole opening (5 cycles) of the faulted line.

   (b) 400 KV D/C line:

   (i) When both the circuits are in operation, the system shall be capable of withstanding a permanent fault on one of the circuits followed by a three-pole opening (100-m sec.) of the faulted circuit.

   [Explanation: - Single pole opening and unsuccessful auto-reclosure is not considered generally in long 400 KV D/C lines since the reclosure facility is by-passed when both circuits are in operation, due to difficulties in sizing of neutral grounding reactors.]

   (ii) When one of the circuits is under maintenance / outage the system shall be capable of withstanding a transient fault on the circuit in service.

3. A permanent 3-phase fault with duration of 8-cycles on 220 KV or 110 KV or 66 KV line assuming three-pole opening.

4. No stability studies for faults are required for radial lines.

11.0 SUBSTATION PLANNING CRITERIA

11.1 For meeting a particular quantum of load the number of substations required depends upon the choice of voltage levels, the MVA capacity and the number of feeders permissible etc. The number
of EHT transformers, interconnecting transformers shall also be considered in planning to take care of contingencies of planned/forced outages. The rupturing capacity of the circuit breakers shall have 20 percent margin to take care of increase in short circuit levels as the system grows. The following criteria can be adopted:

a) The capacity of any single substation at different voltage levels shall not normally exceed:

<table>
<thead>
<tr>
<th>Voltage (KV)</th>
<th>Capacity (MVA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>1000</td>
</tr>
<tr>
<td>220</td>
<td>400</td>
</tr>
<tr>
<td>110</td>
<td>80</td>
</tr>
<tr>
<td>66</td>
<td>80</td>
</tr>
</tbody>
</table>

b) Size and number of interconnecting transformers (ICTs) shall be planned in such a way that the outage of any single unit would not overload the remaining ICTs or the underlying system.

c) Size and number of HT / EHT transformers shall be planned in such a way that in the event of outage of any single unit, the remaining HT / EHT transformers would still supply 80% of the load. This has to be achieved in such a way that, with the interconnection of the adjacent substations, the load exceeding the capacity of the available transformers may be transferred on to them.

d) The rated rupturing capacity of the circuit breakers in any substation shall not be less than 120% of the maximum fault levels at the substations. (The 20% margin is intended to take care of increase in short circuit levels as the system grows). The minimum rated rupturing of capacity of switchgear at different voltage levels are as follows:
12.0 REACTIVE COMPENSATION

12.1 As per I E rules, the power factor of the consumer shall not be less than 0.85 lag for normal working load for which purpose the consumer shall provide appropriately sized capacitor banks, if necessary. Adequate reactive compensation shall be provided by the Licensee to maintain the power factor at 220KV and higher voltages at 0.95 lag or more.

12.2 Suitable shunt reactors shall be provided at 400KV stations for controlling voltages within the limits prescribed. The step changes shall not cause a voltage variation exceeding 5%.

Suitable line reactors shall be provided to enable charging of 400KV lines without exceeding the voltage limits specified. If the voltage rise limits specified are not exceeded in the most adverse case also without shunt reactors, the reactors provided may be switchable.
ANNEXURE

DATA PREPARATION FOR TRANSMISSION PLANNING STUDIES

Actual system data wherever available should be used. In cases where data is not available standard data given below can be assumed.

I. Load Flow and Short Circuit studies:
   i. The Power factor shall be as indicated in Section 4.1.
   ii. Reactive power limits for generator buses shall be as follows:
       \[ Q_{\text{max}} = 50\% \text{ of active generation.} \]
       \[ Q_{\text{min}} = (-) 50\% \text{ of } Q_{\text{max}}. \]
   iii. The desired voltage of generator (PV) buses shall be between 1.03 and 1.05 for peak load conditions and between 0.98 to 1.00 for light load conditions.

   iv. The line parameters (P.U./KM/CKT on 100 MVA base) shall be assumed as follows:

<table>
<thead>
<tr>
<th>Line voltage (KV)</th>
<th>Conductor</th>
<th>Positive sequence</th>
<th>Zero sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>X</td>
</tr>
<tr>
<td>400</td>
<td>Twin Moose</td>
<td>1.862E-5</td>
<td>2.075E-4</td>
</tr>
<tr>
<td>400</td>
<td>Twin AAC</td>
<td>1.934E-5</td>
<td>2.065E-4</td>
</tr>
<tr>
<td>400</td>
<td>Quad Zebra</td>
<td>1.05E-5</td>
<td>1.59E-4</td>
</tr>
<tr>
<td>400</td>
<td>Quad AAC</td>
<td>0.979E-5</td>
<td>1.676E-4</td>
</tr>
<tr>
<td>400</td>
<td>Triple Zebra</td>
<td>1.401E-4</td>
<td>1.87E-4</td>
</tr>
<tr>
<td>Voltage</td>
<td>Transformer</td>
<td>Reactance</td>
<td>Generator Transformer</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>-----------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>220</td>
<td>Drake</td>
<td>8.569E-4</td>
<td>1.310E-3</td>
</tr>
<tr>
<td>110</td>
<td>Lynx</td>
<td>31.40E-4</td>
<td>3.58E-4</td>
</tr>
<tr>
<td>66</td>
<td>Coyote</td>
<td>8.82E-3</td>
<td>1.27E-4</td>
</tr>
</tbody>
</table>

v. Transformer reactance on its own base: MVA
   Generator transformer: 14% to 15%
   Inter connecting transformer: 12.5%

vi. In planning studies all the transformers should be kept at nominal taps and the On Load Tap Changer (OLTC) should not be considered. The effect of the taps should be kept as operational margin.

vii. For short-circuit studies, even though short-circuit levels computed using the sub-transient reactance (X''d) is higher, the transient reactance (X'd) of the synchronous machines shall be used. This is suggested due to the fact, that the circuit breaker would operate only after 100 milliseconds from the time of fault initiation, and by this time the effect of sub-transient reactance would not be present.

viii. For asymmetrical faults, the vector group of transformers, and the inter-winding reactance (for three winding transformers), shall be taken into account.

ix. The generators and the generator transformers shall be represented separately for evaluating the generator bus short-circuit levels.

x. Voltage and frequency dependency of the system loads shall be considered as follows:

| For voltage dependency: | For frequency dependency: |
Active load (P) | $P = P_0 \left(\frac{V}{V_0}\right)$ | $P = P_0 \left(\frac{f}{f_0}\right)$
---|---|---
Reactive load (Q) | $Q = Q_0 \left(\frac{V}{V_0}\right)^2$ | Independent of frequency

Where $P_0$, $Q_0$, $V_0$, $f_0$ are the values at the initial system operating conditions.

II. **Transient Stability studies:**

While carrying out transient stability studies, the export/import to/from the neighbouring region shall be represented as passive loads.

III. **Typical parameters for thermal and hydro machines:**

Machine Data - Thermal / Hydro.

<table>
<thead>
<tr>
<th>Machine parameters</th>
<th>Machine Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thermal</td>
</tr>
<tr>
<td>Rated voltage (KV)</td>
<td>21.00</td>
</tr>
<tr>
<td>Rated MVA</td>
<td>588.00</td>
</tr>
<tr>
<td>Inertia constant (H)</td>
<td>3.07</td>
</tr>
<tr>
<td>Reactance:</td>
<td></td>
</tr>
<tr>
<td>Leakage (Xl)</td>
<td>0.14</td>
</tr>
<tr>
<td>Direct axis (Xd)</td>
<td>2.31</td>
</tr>
<tr>
<td>Quadrature axis (Xq)</td>
<td>2.19</td>
</tr>
<tr>
<td>Transient Reactance:</td>
<td>Direct axis (X’d)</td>
</tr>
<tr>
<td></td>
<td>Quadrature axis (X’d)</td>
</tr>
<tr>
<td>Sub-transient reactance:</td>
<td>Direct axis (X”d)</td>
</tr>
</tbody>
</table>
### Quadrature axis

- **Open circuit time constant**
  - Direct axis $(T'do)$
    - Hydro: 9.0
    - Thermal: 7.0
    - $> 210\text{ MW}$: 9.7
  - Quadrature axis $(T'qo)$
    - Hydro: 2.5
    - Thermal: 2.5
    - $> 210\text{ MW}$: 0.5
  - Sub-transient
    - Direct axis $(T''do)$
      - Hydro: 0.04
      - Thermal: 0.04
      - $> 210\text{ MW}$: 0.05
    - Quadrature axis $(T''qo)$
      - Hydro: 0.2
      - Thermal: 0.2
      - $> 210\text{ MW}$: 0.10

### IV. Typical parameters of exciters:

<table>
<thead>
<tr>
<th>Typical parameters</th>
<th>Hydro</th>
<th>Thermal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$&lt; 210\text{ MW}$</td>
<td>$&gt; 210\text{ MW}$</td>
</tr>
<tr>
<td>Transducer Time Constant $(TR)$</td>
<td>0.040</td>
<td>0.040</td>
</tr>
<tr>
<td>Amplifier gain $(KA)$</td>
<td>25 - 50</td>
<td>25 - 50</td>
</tr>
<tr>
<td>Amplifier Time Constant $(TA)$</td>
<td>0.04 - 0.05</td>
<td>0.04 - 0.05</td>
</tr>
<tr>
<td>Regulator Limiting Voltage</td>
<td>Maximum $(VR_{\text{max}})$</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Minimum $(VR_{\text{min}})$</td>
<td>-4.0</td>
</tr>
<tr>
<td>Feed Back signal</td>
<td>Gain $(KF)$</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>Time Constant $(TF)$</td>
<td>1.0</td>
</tr>
<tr>
<td>Exciter</td>
<td>Gain $(KE)$</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Time Constant $(TE)$</td>
<td>0.7</td>
</tr>
</tbody>
</table>
V. Transient/Dynamic Studies:
System shall be, to the extent possible, represented in detail. Parallel circuits/alternate paths shall also be considered. At least one source shall be considered for detailed representation. Saturation characteristics of transformers and reactors shall also be considered. Appropriate data for these studies shall be used.

VI. Voltage Stability Studies:
The studies shall be carried out using Load Flow analysis program by creating a fictitious synchronous condenser at the most voltage sensitive bus i.e., bus converted to PV bus. By reducing the desired voltage of this bus, MVAR generation/absorption is monitored. When voltage is reduced to the level beyond which the MVAR absorption does not increase by reducing the voltage further and instead it gets reduced. This voltage will be the Knee point of QV curve and represents instability. The horizontal 'distance' of the knee point to the zero-MVAR vertical axis measured in MVARs, is the indicator of the proximity to the voltage collapse.

VII. Line loading limits:
1. Thermal limit:
The thermal loading limits for various sizes of conductors are as below:

<table>
<thead>
<tr>
<th>AMBIENT TEMP IN DEG C- →</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coyote</td>
<td>26/2.54+7/1.905</td>
<td>476</td>
<td>452</td>
<td>428</td>
<td>404</td>
<td>378</td>
<td>351</td>
</tr>
<tr>
<td>Kundah</td>
<td>42/3.50+7/1.96</td>
<td>962</td>
<td>915</td>
<td>867</td>
<td>816</td>
<td>764</td>
<td>710</td>
</tr>
<tr>
<td>Zebra</td>
<td>54/3.18+7/3.18</td>
<td>1011</td>
<td>962</td>
<td>911</td>
<td>858</td>
<td>804</td>
<td>747</td>
</tr>
<tr>
<td>Deer</td>
<td>30/4.267+7/4.267</td>
<td>1037</td>
<td>986</td>
<td>934</td>
<td>880</td>
<td>824</td>
<td>765</td>
</tr>
<tr>
<td>Drake</td>
<td>26/2.442+7/3.454</td>
<td>989</td>
<td>941</td>
<td>891</td>
<td>840</td>
<td>786</td>
<td>730</td>
</tr>
<tr>
<td>Moose</td>
<td>54/3.53+7/3.53</td>
<td>1156</td>
<td>1100</td>
<td>1041</td>
<td>981</td>
<td>919</td>
<td>853</td>
</tr>
<tr>
<td>Falcon</td>
<td>54/4.359+19/2.626</td>
<td>1545</td>
<td>1470</td>
<td>1392</td>
<td>1311</td>
<td>1228</td>
<td>1141</td>
</tr>
</tbody>
</table>
2. **Surge impedance loading:**

Surge Impedance Loading for different conductor configurations are as follows:

<table>
<thead>
<tr>
<th>VOLTAGE (KV)</th>
<th>No. and size of conductor</th>
<th>S.I.L. (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>2 X 520 Sq.mm.</td>
<td>515</td>
</tr>
<tr>
<td>400</td>
<td>4 X 420 Sq.mm.</td>
<td>614</td>
</tr>
<tr>
<td>400</td>
<td>3 X 420 Sq.mm.</td>
<td>560</td>
</tr>
<tr>
<td>400</td>
<td>2 X 520 Sq.mm.</td>
<td>155</td>
</tr>
<tr>
<td>220</td>
<td>250 Sq.mm.</td>
<td>132</td>
</tr>
<tr>
<td>110</td>
<td>110 Sq.mm.</td>
<td>50</td>
</tr>
<tr>
<td>66</td>
<td>80 Sq. mm.</td>
<td>35</td>
</tr>
</tbody>
</table>

The permissible line loading as a function of line lengths and SIL are indicated in the graph annexed and these figures can be used only for planning purposes and when detailed line design is not yet made.
LINE LOADING AS A FUNCTION OF LENGTH
TRANSMISSION SYSTEM MANAGEMENT AND OPERATING STANDARD

1.0 OBJECTIVE

1.1 The Transmission System Management and Operating Standard has been prepared pursuant to Section 33 of the Karnataka Electricity Reform Act, 1999 and Part III, Section 16 of the Karnataka Electricity Regulatory Commission (Licensing) Regulations, 2000.

2.0 SCOPE

2.1 This standard formulates guidelines for grid operation. The scope of this standard covers:

(a) Data management and system studies.
(b) Load despatch and communication
(c) Voltage and reactive power management.
(d) Demand management.
(e) System operation.

2.2 This standard shall serve as guidelines for the Transmission Licensee to operate the transmission system for providing an efficient, coordinated and economical system of electricity transmission to ensure power supply to consumers at the specified level of voltage and frequency. To operate the transmission system efficiently, it is very important for the Transmission Licensee to collect, store & manage detailed up to date data of the complete system to enable carrying out system studies whenever required. The details of system data to be collected and stored shall generally be as indicated in Annexure-1.

2.3 The definitions of several terminologies used in this standard as well as in other standards are covered in the "Grid Code".
3.0 DATA MANAGEMENT AND SYSTEM STUDIES

3.1 The Transmission Licensee shall carry out the following system studies as often as required after acquiring detailed up to date data relating to the transmission system and the generating system (including that of Captive Power Plants (CPPs)).

a) Load flows under different conditions of operation.
b) Steady state and transient stability limits of the system.
c) Location and extent of reactive power compensation required in the system for maintaining satisfactory voltage profile in the system.
d) Fault levels at different points in the system.
e) Transient & dynamic studies

4.0 LOAD DESPATCH

4.1 The Transmission Licensee shall be able to perform the following functions from the State load despatch center.

- Daily generation load scheduling and issuing despatch instructions.
- Monitoring line MW and MVAR drawals, EHT bus Voltages and Frequency.
- Monitoring generation output, export/import at various points of interconnection.
- Coordination of restoration process after partial or total blackouts in the transmission system.
- Finalization of outage plan for transmission system for carrying out maintenance, construction, modification, diversion etc., in coordination with the generation system and distribution system so that the security standards of the transmission system are not affected.
- Assignment of spinning reserve capacity on each system and the coordination of spinning reserve capacity utilization in the integrated system.
- Installation of devices for automatic tripping of non-critical loads/major transmission lines and generation to maintain frequency within set limits.
• Co-ordinated studies to review adequacy of the system and inter-system design and operating practices under unusually severe system disturbances.

• Issue of standing instructions to operating staff of each system to deal with separation of the system from inter-connected network.

5.0  COMMUNICATION

5.1 The Transmission Licensee shall establish reliable and efficient point-to-point voice and data communication links between State Load Despatch Centre (SLDC), Southern Regional Load Despatch Centre (SRLDC), Generating Stations and EHT substations.

5.2 All operational communications/instructions transmitted by/to SLDC shall be recorded as evidence of the communications/instructions.

6.0  REACTIVE POWER MANAGEMENT

6.1 The Transmission Licensee shall endeavour for optimum use of the existing reactive resources and the reactive reserves in the system to meet the steady state voltage limits at all buses in the transmission system as set in “Transmission System Planning and Security Standard”.

7.0  VOLTAGE MANAGEMENT

7.1 The Transmission Licensee shall monitor voltage levels at all EHT substations of its transmission system on real time at SLDC by installing data acquisition system.

7.2 Since voltage is affected both by reactive power flow and frequency, system voltage shall be regulated by taking all feasible measures to regulate system reactive power flows and frequency.

7.3 All local voltage problems shall be remedied to the extent possible by operating local transformer taps.
7.4 In case of system high voltage, the Transmission Licensee shall take the following measures:

- Address the high frequency problem.
- Request generating plants to decrease MVAR generation in accordance with machine capability curves.
- Switch in bus reactors where provided.
- Switch out capacitors where provided (if they are switched in).
- Reduce taps of 400/220 KV interconnecting transformers.
- Switch out one circuit of double circuit transmission line (if lightly loaded).

7.5 In case of system low voltage:

- Address low frequency problem.
- Request generating plants to increase MVAR generation in accordance with machine capability curves.
- Switch out bus reactors (if they are switched in).
- Switch in capacitors.
- Increase system Voltage by changing the taps of 400/220 KV and 220/110 KV interconnecting transformers.
- Restoration of circuits under outage.
- Demand reduction.

8.0 DEMAND MANAGEMENT

8.1 The Transmission Licensee shall monitor MW/MVAR loading of each EHT line and each interconnecting transformer on real time basis at SLDC by installing data acquisition system.

8.2 Similarly the loading on each power transformer at EHT substation shall be closely monitored during peak load hours.

8.3 If any system component is being overloaded/overheated, the load on the same shall be reduced following suitable procedure.
9.0 UNDER FREQUENCY LOAD SHEDDING

9.1 The Transmission Licensee in consultation with the users of the transmission system shall check whether there is any excess drawal at any points of interconnection by any Distribution & Retail supply Licensee and advise him to restrict his drawal within schedule. If there is no such excess drawal, and there is also no possibility of increasing the generation by the generating companies, load shedding should be done by tripping such of the lines as found necessary and appropriate at that time in consultation with SLDC. Under frequency relays appropriately set shall be provided for the purpose wherever possible.

10.0 ISLANDING SCHEME

To avoid total blacking out of the grid during system disturbances and for early normalization, islanding schemes for major generating stations (especially nuclear and thermal power stations) and part/parts of the transmission system shall be developed in consultation with SRLDC.

11.0 POST DISTURBANCE ANALYSIS-

11.1 All major grid disturbances causing tripping of generating units (90MW and above), tripping of EHT lines (220KV and above) causing full/partial system blackout, breakdown of EHT lines causing prolonged interruption and load restrictions shall be promptly discussed in the Grid Code review Panel. This shall be done following discussion and analysis in any Sub-panel that may be formed by the Panel for the purpose, immediately after the occurrence. Disturbance reports and recommendations made in such meetings shall be compiled and circulated to all members of the Grid Code review Panel for implementation.
12.0 **EVENT REPORTING**

12.1 The Transmission Licensee shall monitor all abnormal occurrences or events affecting the operation of the system as outlined in the Grid Code in section “Operational event/Accident reporting”.

12.2 The Transmission Licensee shall ensure that within 10 minutes of an occurrence, verbal/V-Sat communication shall be made to a designated officer by the officer in charge of the shift of SLDC who shall have authority to intimate follow up action as deemed fit. The shift officer at SLDC must, however, give utmost priority in safeguarding the system before initiating the reporting procedure.

12.3 Within one hour of restoration of normalcy, a preliminary report shall be prepared (in a form to be standardized by the Transmission Licensee) and communicated to the designated officer/officers.

12.4 Within 48 hours, a detailed report shall be prepared (in a form to be standardized by the Transmission Licensee) and communicated to the designated officer/officers.

13.0 **OUTAGE PLANNING**

13.1 The Transmission Licensee shall see that the outage planning of the transmission system is coordinated with SLDC as detailed in Section 3.0 of the Power supply management and operating standards, at the same time ensuring that the security standards of the transmission system are not violated.

14.0 **PROTECTION COORDINATION**

14.1 The Transmission Licensee shall coordinate the settings of relays in the protection schemes of the transmission system with those of the
generating companies, PGCIL and grid system of neighboring states at respective points of interconnection.

15.0 FAULT LEVELS
15.1 As a routine measure the Transmission Licensee shall intimate all users of the transmission system, the approximate fault level of the transmission system at each point of interconnection both at EHT bus and at HT bus.

16.0 ON LOAD CHANGING
16.1 The Transmission Licensee shall prepare a schedule for operation of on-load taps of load transformers and interconnecting transformers at each EHT substation in the transmission system under different generation and load dispatches as simulated in the system studies and enforce its implementation under similar situations obtained in practice.

17.0 SAFETY COORDINATION
17.1 The Transmission Licensee shall observe the general safety requirements as laid down in IE rules for construction; installation, protection, operation and maintenance of electricity supply lines and apparatus.

17.2 The Transmission Licensee shall designate suitable control persons as specified in Grid Code for coordination of safety procedures before work is taken up, during work and after work is completed till the concerned system component is energized, both inside its own transmission system and across a control boundary between its transmission system and that of any User.

17.3 The Transmission Licensee shall develop its own safety manual for the purpose of safety coordination.
18.0 MAINTENANCE SCHEDULES
18.1 The Transmission Licensee shall develop maintenance schedules of lines and substation equipment in conformity with relevant CBI&P manuals/manufacturers' maintenance manuals.

19.0 MAINTENANCE STANDARDS
19.1 The Transmission Licensee shall establish a hierarchy for implementation of the maintenance standards and its monitoring as follows:

(i) No EHT line shall suffer a total interruption for more than 175 hours in a year including planned outages but excluding force majeure causes.

(ii) No HT supply of the Distribution & Retail Supply Licensee shall suffer total interruption for more than 150 hours excluding the actual interruption period of EHT lines by which the interruptions to the respective HT line is caused in a year at the substation including planned outages.

20.0 SPARES
20.1 For convenience of maintenance, repairs and replacement of line equipment and substation equipment, the Transmission Licensee shall develop a suitable policy on spare parts.

21.0 TESTING LABORATORIES
21.1 The Transmission Licensee shall establish testing laboratories of its own, or have arrangements with testing laboratories approved by KERC, fully equipped for routine testing of relays, meters, CTs, PTs, condenser bushings and other electrical accessories used in substations in accordance with relevant Indian standards and manufacturer’s instructions.
22.0 TESTING ORGANIZATION
22.1 The Transmission Licensee shall establish testing organizations under its control, staffed with qualified, trained and skilled persons and equipped with all necessary testing equipment, power supply etc., for conducting field tests of substation equipment such as transformer, Circuit breaker, CT, PT, Station battery, relays and meters, control wiring, cables, lightning arresters, substation earthing, etc. Alternatively the Transmission Licensee shall have arrangements with any standard testing laboratory approved by the KERC for conducting all the required tests.

23.0 TOOLS AND TACKLES
23.1 The Transmission Licensee shall maintain in good order and condition all necessary equipment, tools, tackles etc., for carrying out maintenance of lines, substation equipment and ensure their availability at all substations.

24.0 INSPECTION OF LINES AND SUBSTATIONS
24.1 The Transmission Licensee shall carry out periodical inspection of all lines and its sub-stations its transmission system, through an inspection team qualified for the purpose to ensure that maintenance of lines and substations is carried out as per maintenance schedules.

*****
Data for operation and studies.
All data should be on 100 MVA base.

1. **LINE DATA FOR LINES OF 110 KV LEVEL AND ABOVE.**

From Bus No.:
From Bus name:
To Bus No.:
To Bus Name:
Voltage Level (KV):
CKTS No.:
Line length(KM):
Conductor Size and No. of conductors per phase:
Pos. Sequence Resistance /Km (in P.U.):
Pos. Sequence Reactance /Km (in P.U.):
Pos. Sequence Half-line susceptance/Km (in P.U.):
Zero Sequence Resistance /Km (in P.U.):
Zero Sequence Reactance /Km (in P.U.):
Zero Sequence Half line susceptance/Km (in P.U.):
Line capacity (amps)(specify ambient temperature °C and temperature rise over ambient in °C)
Line reactors (if any) (at both ends) MVAR:
Year of commissioning:
2. TRANSFORMER DATA FOR ALL 400/220 KV AND 220/110 KV AUTOTRANSFORMERS AND GENERATOR TRANSFORMERS.

From Bus No.:
From Bus name:
To Bus No.:
To Bus Name:
Voltage on HV Side (KV):
Voltage on LV Side (KV):
No. of Transformers:
Resistance (in P.U.):
Reactance (in P.U.):
Tap setting:
Nominal Tap:
Tap Step:
Tap Range:
Transformer Type (2 or 3 winding. Vector Group):
Rating of Transformer (MVA):
Year of Commissioning:
Special data for 3 winding Transformer
Impedance between (P.U.)
HV-MV:
MV-LV:
HV-LV:
Voltage on HV side:
Voltage on MV side:
Voltage on LV side:
Loading capacity of Tertiary (if any):
Grounding impedance in P.U.:
(if the neutral of the star is grounded)
3. Bus Data:
Bus No.:
Name of Bus:
Bus Voltage (KV):
Gen. Bus/Load Bus:
P gen. (MW):
Q gen. (MVAR):
P Load (MW):
Q Load (MVAR):
V obtained from Gen. Bus:
MVAR Capability curve for generators:
Shunt reactor, if any:
Shunt capacitor if any:

4. **MACHINE DATA**

A) **GENERATOR DATA**
Capacity MVA, MW, MVAR, (minimum) & MVAR (Maximum)
Generator voltage in KV nominal, minimum, maximum
Sequence impedance of winding on its ‘own’ base/Grounding impedance.
Direct Axis
Synchronous Reactance
Transient Reactance
Sub-transient reactance
Quadrature Axis
Synchronous Reactance
Transient Reactance
Sub-transient reactance
Inertia constant in MW-Sec/MVA
Damping constant
Armature Resistance
Armature Leakage Reactance
Direct Axis
Transient time constant
Sub- transient time constant
Maximum continuous rating.

B) TURBINE DATA
Type of Turbine i.e. Hydro/Steam, Francis, Kaplan etc.
Block diagram of turbine model along with the values of gain constants and time constant.
Turbine damping constant kd
Speed of machine, nominal speed
Any other constants as described in the block diagram of Turbine model.

C) EXCITER DATA
a. Block diagram of exciter model along with the values of gain and time constant like:

1.0 VOLTAGE REGULATOR GAIN AND TIME CONSTANT
Main exciter gain and time constant

1.0 STABILIZING LOOP/CLOSED LOOP GAIN AND TIME CONSTANT

b. Power system stabilizer data.

D) SPEED GOVERNOR DATA.
Block diagram of governor model along with the values of gain and time constant.
Max. & Min. valve position limits.
Effective speed governor system gain
Valve servo time constant.
5. **DEMAND DATA FOR ALL 220 KV AND 110 KV SUBSTATIONS**

1. **Weekly MW/MVAR load details.**
   MW/MVAR loading should indicate the percentage of agricultural load, industrial load, domestic load & commercial load separately.

   Restrictions imposed
   Assessed reduction in Demand due to restrictions

1.0 **UNRESTRICTED DEMAND**

: MW
: MVAR

2. **Name of Substation:**
   Typical daily load curve (for week day 7 week end)
   Under restricted demand
   Under unrestricted demand

6. **REAL TIME DATA**
   Each Generating Unit – Generation MW
   All 400/220 KV line flow – MW and MVAR
   All 400/220 KV transformer flow – MW and MVAR
   All 400/110 KV transformer flow – MW and MVAR
   Bus voltages at 400, 220 KV buses.
   Tap positions – 400/220 KV, 400/110 KV & 220/110 KV Transformers.
   Status of circuit breaker positions of all 400 KV, 220 KV and 110 KV lines, transformers, generators.

***
METERING CODE

POM CODE-5
METERING and Protection Standards
1.0 Scope

This Code specifies the minimum requirement of Metering to be provided at the interface between Generating Stations, Transmission and Bulk Supply Licensee, and Distribution and Retail Supply Licensees and for the purpose of monitoring and tariff requirements.

2.0 Objective

The main objective of this Code is to formulate the detailed methodology to be followed by the concerned Licensees to provide the required Metering for tariff purposes and also for a smooth and healthy operation of the Power System to meet the specified standards of electrical power. This Code is applicable for the requirements of Metering at Generating Stations, Sub-stations and the Technical Interface between any two Distribution and Retail Supply Licensees at the point of interconnection for:

a) Tariff Metering for Active, Reactive Energy and frequency at delivery points of Generating Stations to Transmission System and Active and Reactive energy along with Maximum Demand at delivery points of the Transmission System of the Transmission and Bulk Supply Licensee's sub-stations to the Distribution System.

b) Operational Metering for Active and Reactive Power and monitoring of Power Stations and Grid Sub-stations at connection points.

3.0 Metering Standards

The Metering to be provided at the Power Stations, Sub-stations and the Distribution Systems shall meet the specific requirements of the "Metering and Protection Standard" issued separately. This standard forms an integral part of this Code.
The words “Purchaser” and “Supplier” used throughout this Code shall represent the following parties:

a) At the Technical Interface between the Generating Station and the Transmission and Bulk Supply Licensee’s System, the Generating Company is the “Supplier” and the Transmission and Bulk Supply Licensee is the “Purchaser”.

b) At the Technical Interface between the Transmission and Bulk Supply Licensee’s System and the Distribution and Retail Supply Licensee’s System, the Transmission and Bulk Supply Licensee is the “Supplier” and the Distribution and the Retail Supply Licensee is the “Purchaser”.

4.0 Energy and Power Metering

4.1 Each Generating Station shall have separate Tariff Metering. Each Power Transformer of a Grid sub-station supplying power to Distribution and Retail Supply Licensees shall have separate Tariff Meters on the Low Voltage side.

4.2 At each of the Tariff Metering point both Main and Check Meters shall be provided. The Supplier shall provide the Main Meter and the Purchaser shall provide the Check Meter. The Tariff Meter shall be connected at the delivery point. At the delivery points, both the Main and Check Meters shall be Electronic Trivector Meter. If the existing system does not meet the requirements of this Code, a Final Metering Scheme is to be evolved by the concerned Licensees in accordance with this Code within a specified time Schedule to be mutually agreed upon with the approval of the Commission.
4.3 The ownership, maintenance and testing of the Main Tariff Meter rest with the Suppliers. Similarly the ownership, maintenance and testing of Check Meters rest with the Purchaser. Each party, shall by the applicable date, become bound by this Metering Code in this respect and ensure that the required Metering is properly installed and that they comply with the requirements of this Metering Code.

5.0 Co-ordination Committee
A Co-ordination Committee shall be established between the Purchaser and Supplier for formulating Operational Procedures and regulate relations between the parties, the repairs and maintenance of equipments at the point of supply including the Metering equipment, taking Meter readings and providing the available data and evidence relating to Metering. The Coordination Committee shall consist of three members; with one representative, who is an expert in Metering, from each of the parties concerned and the third member shall be a person who is a member of the Grid Code Review Panel mutually agreed upon by both the parties. Only the Grid Code Review Panel formed under the provisions of Grid Code can review the Metering Code. If the coordination Committee suggests any revision to the Metering Code, the Licensee may approach the Grid Code Review Panel for the same.

6.0 Data Collection
The Transmission and Bulk Supply Licensee shall have the right to collect all the data relating Operational Metering.

7.0 Accuracy
7.1 Metering shall be accurate within the prescribed limits and calibrated periodically as specified in the “Metering and Protection Standards”. If at any time the net Metered energy as reckoned from the reading of
the Main Meter differs from that of Check Meter beyond 0.5% both the Main and Check Meters shall be calibrated. The Sub-standard Meters used for the purpose of test and calibration shall be got calibrated and sealed at a Government Authorized Meter Testing House/Laboratory or at a mutually agreed testing Laboratory once a year. Record of testing and calibration of Substandard Meters shall be maintained by the Transmission and Bulk Supply Licensee. If it is not possible to calibrate, such meter shall be replaced.

7.2 It is the responsibility of every Licensee and the Generating Companies to keep the Meters in good working order at their own expense. Any new or replacement Meter shall be tested as soon as reasonably practicable after installation. Before calibration and testing by any Licensee except in the circumstances necessitated by emergencies or equipment failure, at least 5 days notice shall be given to his counterpart to enable him to witness the same if he so desires.

8.0 Records

8.1 Each Licensee shall maintain a register for the Meters for which he is responsible. Each register shall contain all the information relevant to specifications such as serial number, accuracy class, all the relevant matters as may be required relating to calibration including dates, location, result of tests, readings, adjustments or inspections carried out. Any temporary or permanent replacement of Meters and the dates on which any seal was applied or broken and the details of persons carrying out and attending such tests, readings, inspection and sealing shall be properly recorded. All such records shall be complete and accurate and retained for at least three years. The Transmission and Bulk Supply Licensee may insist on any other details, which he feels reasonably relevant, and these shall also to be included
in the register. Any data forming part of such Metering record shall be made available to the interested party on request.

8.2 Each Licensee shall pass on such records or copies of the above to his successor in relation to any Metering. Each Licensee and Generating Company shall at his own cost and expense, provide copies of all these records to the Transmission and Bulk Supply Licensee.

9.0 Sealing

9.1 The points of sealing shall be:

a) CT secondary boxes
b) PT secondary boxes
c) Meter box
d) Meter test block
e) Meter terminal cover
f) Meter cover
g) Panel doors where CT and PT secondary circuits are terminated and fuses, links etc., are available
h) PT selector relay where automatic change-over of potential supply to Meter from one PT to another is provided
i) CT primary links and top covers of CT where ratio changes are by primary change over

9.2 Following the effective date, the Purchaser and Supplier shall seal all Tariff Metering. The seal shall be replaced following any test or inspection.

9.3 The seal should not be broken or removed except in the presence of both the Purchaser and the Supplier concerned or with the prior consent of the party affixing the seal. The seals of Tariff Meters shall be
broken in the presence of the representatives of both the concerned parties, i.e., Supplier of energy who raises the bill and the Purchaser who pays the bill.

9.4 Each party shall control the issue of its own sealing pliers and shall keep an accurate register of all such pliers and authorized persons to whom they are issued.

10.0 Periodical Testing

10.1 The Transmission and Bulk Supply Licensee shall ensure that all the Meters, which are subjected to this Code, are regularly tested at least once in a year. The testing shall be carried out in presence of the parties concerned, viz., the Purchaser and the Supplier. For this purpose, at least a five-day’s prior notice shall be given to all the interested parties. The Transmission and Bulk Supply Licensee shall maintain a record of all such tests and provide copies of the same to the interested parties.

10.2 The readings of the Meters shall be taken jointly by the representatives of the Purchaser and Supplier concerned on a specified date and time mutually agreed upon.

11.0 Access

Both the Supplier and the Purchaser shall provide access to each other, their employees, agents and contractors and persons duly authorized by them, full right to enter and remain upon any part of such party’s property to the extent necessary for the purpose of this Code. This right to access includes the right to bring in vehicles, test kits and required plant and machinery, loading kits, sub-standard Meters etc.
12.0 Meter failures
If at any time both Main and Check Meter ceases to function for any reason, or the PT fuse on the circuit supplying the Meter has failed, the Meter readings from the time of such occurrence to the time of rectification shall be computed as per the agreed procedures in the Power Purchase Agreement.

13.0 Disputes
Any dispute relating to the Metering, which can affect any payment to be made shall be dealt with in accordance with the relevant dispute resolution mechanism provided under Power Purchase Agreement.

***
1.0 Scope

This standard provide guidelines for the following:

Minimum requirement of metering for commercial and operational purposes to be provided by the User at Interconnection Points including Generating Stations, Switching Stations, Substations and also Cross Boundary Circuits.

Minimum requirement of protection to be provided to safeguard the system from faults which may occur.

2.0 Objective

The objective of these standards is to define the following requirements for a safe and economical operation of the system consistent with the Licence requirements:

1. The acceptable minimum metering equipment required.
2. The acceptable minimum protection requirements to be provided for the various components of Transmission and Distribution Systems for minimizing disruption due to faults.

I. METERING REQUIREMENTS:

3.0 Generating Station Operational Metering:

3.1 The Generating Companies shall install operational metering to the Licensees' specifications so as to provide operational information for both real time and recording purposes to SLDC in relation to each generating unit at each Power Station in respect of the following:

- Bus voltage
- Frequency
- MW
- MVar
Any other data agreed to between the Licensee and the Generating Company

3.2 All the Instrument Transformers used in conjunction with the operational metering shall be of accuracy class 0.5 and shall be of suitable rating to meet the burden of lead wires and meters and shall conform to the relevant IEC or IS specifications.

3.3 All the meters shall be calibrated to achieve the overall accuracy of Operational Metering in accordance with the limits agreed to between the Transmission Licensee/Distribution & Retail Supply Licensee and the Generating Company. Records of calibration shall be maintained for reference and shall be made available to the Licensee, upon request. Joint site testing shall be carried out at least once in six months.

4.0 Transmission System Operational Metering

4.1 The Transmission Licensee shall install Operational Metering for both real time and recording purposes at each substation as follows:

1. For Station Busbars:
   - Bus Voltage.
   - Frequency.

2. For Outgoing/Incoming Lines, Power Transformers, Auxiliary Transformers and Compensating Devices:
   - MW.
   - MVAr.
   - Power Factor.
   - Current

5.0 Supervisory Control And Data Acquisition (SCADA)

5.1 The Transmission Licensee shall install and make operative an Operational Metering Data Collection System under SCADA for storage, display and processing of Operational Metering Data. All Users
shall make available outputs of their respective Operational Meters to the SCADA interface equipment.

5.2 The data collection, storage and display centre shall be the State Load Despatch Centre (SLDC).

6.0 Tariff Metering

6.1 The Generating Companies, the Transmission Licensees and the Distribution & Retail Supply Licensees shall install the following meters for all the transmission and sub-transmission lines connecting the Generating Stations, Switching Stations and Substations for the measurement of energy import/export from each line, energy generated in generating units and energy consumed in power stations and substations:

- Active Energy Import.
- Active Energy Export.
- Reactive Energy Import.
- Reactive Energy Export.

6.2 The Auxiliary transformers in generating stations shall be provided with the following meters:

- MW
- Current
- Voltage
- Active
- Energy

6.3 Each metering point associated with determination of energy exported or imported, between the Generating Companies, Transmission Licensees and Distribution & Retail Supply Licensees shall be provided with both main and check meters. The minimum standard of accuracy for these meters shall be Accuracy class 0.2.

6.4 All the Instrument Transformers used in conjunction with commercial (tariff) metering shall also be of accuracy class 0.2 and shall conform to
the relevant IEC or IS specifications. The rating shall take into account the burdens imposed by lead wires and metering.

6.5 Data shall be collected from both the main and check metering schemes.

6.6 Voltage failure relays shall be provided to initiate alarm on loss of one or more phases of the voltage supply to the meter.

6.7 All the meters shall be tested and calibrated at least once in one year using substandard meters for this purpose. The standard meters shall be calibrated and sealed at Govt. Authorized Meter Testing House/Laboratory once in every year. Record of testing and calibration of substandard meters shall be maintained by the Transmission Licensee according to the guidelines provided in the relevant IEC/IS specifications.

6.8 Records of these calibrations and tests shall be maintained for reference.

6.9 In case of Inter State Transmission Lines, meters suitable for Availability Based Tariff shall be provided having the following parameters

- Maximum Demand at every 15 minute interval Import
- Maximum Demand at every 15 minute interval Export
- Active Energy Import
- Active Energy Export
- Reactive Energy Import
- Reactive Energy Export
- Frequency at 15 minute interval

6.10 The Generating Companies, Transmission Licensees and Distribution & Retail Supply Licensees shall formulate a procedure covering summation, collection and processing of tariff meter readings at
6.11 various interconnection sites in their areas. Whenever necessary, these procedures can be revised.

6.12 The ownership, responsibility of maintenance and testing of these meters shall be as mutually agreed to between the Users and the Licensees.

6.13 A comprehensive METERING CODE covering the foregoing provisions shall be developed by the Transmission Licensee and shall form a part of the Grid Code.

II. PROTECTION REQUIREMENTS

7.0 General Principles

7.1 No item of electrical equipment shall be allowed to remain connected to the system unless it is covered by the appropriate protection aimed at reliability, selectivity, speed and sensitivity. The guidelines mentioned in the "Manual on protection of Generators, Generator Transformers, and 220 KV and 400 KV networks" vide publication no 274 of C.B.I.P shall be kept in view. All the Generating Companies and the Distribution & Retail Supply Licensees shall cooperate with the Transmission Licensee to ensure correct and appropriate settings of protection to achieve effective, discriminatory isolation of faulty line/equipment within the target clearance times specified elsewhere in this Standard.

7.2 Protection settings shall not be altered, or protection bypassed and/or disconnected without consultation and agreement of all affected Users. In case the protection has been bypassed and/or disconnected by agreement due to any cause, the same should be rectified and protection restored to normal condition as quickly as possible. If
agreement has not been reached, the electrical equipments shall be isolated forthwith.

8.0 Protection Coordination

8.1 The settings of protective relays starting from the Generating Unit up to the remote end of 66KV / 33 KV and 11 KV lines shall be such that only the faulty section is isolated under all circumstances. The Transmission Licensee shall notify the initial settings and any subsequent changes to the Users from time to time. Routine checks on the performance of the protective relays shall be conducted and any malfunction shall be noted and corrected as soon as possible. The Transmission Licensee shall conduct Short Circuit studies required for deciding the relay settings, with the data collected from the Users. Representatives of the Generating Companies, Transmission Licensees and Distribution & Retail Supply Licensees shall meet periodically to discuss such malfunctions, changes in the system configuration, if any, and possible revised settings of relays.

8.2 The Transmission Licensee shall be responsible for arranging periodical meetings between the Generating Companies and the Distribution & Retail Supply Licensees to discuss coordination of protection. The Transmission Licensee shall investigate any malfunction of protection or other unsatisfactory protection issues. The concerned Licensees shall take prompt action to correct any protection malfunction or issue as discussed and agreed to in these periodical meetings.

9.0 Fault Clearance Time

9.1 From stability considerations, the maximum Fault Clearance Time for faults on any User’s system directly connected to the Transmission
System, or any faults on the Transmission System itself, shall be as follows:

<table>
<thead>
<tr>
<th>Voltage Class</th>
<th>Target clearance time</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 400 KV</td>
<td>100 m sec.</td>
</tr>
<tr>
<td>(b) 220 KV</td>
<td>120 m sec.</td>
</tr>
<tr>
<td>(c) 110 KV</td>
<td>160 m sec.</td>
</tr>
<tr>
<td>(d) 66 KV</td>
<td>300 m sec.</td>
</tr>
</tbody>
</table>

9.2 Lesser fault clearance time than the above are preferable.

9.3 Lower Fault Clearance Times for faults on a User’s system may be agreed to, but only if, in the opinion of the Transmission Licensee, system conditions allow the same. At the Generating Stations, Line Faults should be cleared at the Generating Station end, within the critical time, to keep the Generators in Synchronism.

10.0 Generator requirements

10.1 All Generating Units and all associated electrical equipment of the Generating Company connected to the Transmission System shall be protected by adequate protection, as per C.B.I.P. manual vide publication 274, so that the Transmission System does not suffer due to any disturbances originating at the Generating Unit.

11.0 Transmission line requirements

11.1 Every EHT line taking off from a Power Station or a Substation or a switching station shall necessarily have distance protection along with other protections as follows:

(a) 400 KV lines: These lines shall have two main distance protections viz., Main I and Main II with permissive inter trip for remote earth fault. Three zone static/numerical non-switched distance protection with permissive inter trip for accelerated tripping at remote end in case of zone 2 fault as Main I protection shall be provided. Main II protection shall be similar fast protection using
direction comparison or phase comparison carrier relay scheme. In addition to the above, single pole tripping and single shot single pole auto reclosing after an adjustable dead time shall be provided. In addition to the above backup protection with OCR and EFR shall be provided.

(b) **220 KV lines:** Three zone static/numerical non-switched distance protection, with permissible intertrip for end zone fault as main protection in case of zone 2 fault shall be provided. The backup shall be three-phase directional over current relay and earth fault relay protection. One pole tripping and Single Shot Single Pole Auto-reclosing with adjustable dead time shall be provided for the stability of the power system. However, for short 220 KV lines directional comparison or phase comparison carrier protection as Main II can be provided. In addition to the above backup protection with directional OCR and directional EFR shall be provided.

(c) **110 KV/66 KV lines:** Three zone static/numerical switched protection with permissible inter trip for accelerated tripping at remote end in case of zone 2 protection shall be provided as main protection. The backup will be directional three-phase over current and earth fault protection.

(d) **Busbar Protection:** Adequate busbar protection for the Station Busbar sections in all 400 KV and 220 KV class substations shall be provided.

(e) **Local Breaker Backup Protection (LBB):** In the event of any circuit breaker failing to trip on receipt of trip command from protective relays, all circuit breakers connected to the Bus Section to which the faulty circuit breaker is connected are required to be tripped with minimum possible delay through LBB protection. This protection also provides coverage for faults between the circuit breaker and the current Transformer, which are not covered by other protections. All 220 KV and 400 KV circuits shall have Local Breaker Backup Protection.

(f) **400 KV class Power Transformers:** These shall be provided with differential protection, restricted earth fault protection, Bucholtz protection, and winding temperature protection along with backup directional HV & LV IDMT over current protection.

(g) **220 KV, 110 KV and 66 KV class Power Transformers:** These shall have differential protection, restricted earth fault protection,
Bucholtz protection, and winding/oil temperature protection. They shall also have directional over current as backup protection with an instantaneous element. In addition to the above, Over Fluxing Relays, Pressure Relief valves/diaphragms shall be provided for all the power transformers. Appropriate fire protection for all the power transformers as per CBIP specifications and tariff advisory committee recommendations shall be provided.

(h) **Distribution System**: For smaller Transformers of HV class on Distribution System, differential protection shall be provided for 8 MVA capacity and above along with backup time lag over current and earth fault protection with directional feature for parallel operation. Transformers of 1.6 MVA capacity and above but less than 8 MVA shall be protected by time lag over current, earth fault and instantaneous restricted earth fault relays. In addition, all Transformers of 1.6 MVA and above shall be provided with gas operated relays, winding and oil temperature protection.

(i) **Distribution Lines**: All the 33 KV and 11 KV lines at connection points shall be provided with a minimum of over current and earth fault relays as follows:

i. **Plain Radial Feeders**: Directional over current and earth fault relays with suitable settings to obtain discrimination between adjacent relay settings.

ii. **Parallel/Ring Feeders**: Directional time lag over current and earth fault relay.

iii. **Long Feeders/Transformer Feeders**: These feeders shall incorporate a high set instantaneous element.
Karnataka Electricity Regulatory Commission

SAFETY STANDARD FOR CONSTRUCTION AND MAINTENANCE OF TRANSMISSION LINES AND SUBSTATIONS
SAFETY STANDARD FOR CONSTRUCTION AND MAINTENANCE OF TRANSMISSION LINES AND SUBSTATIONS

Scope
This Standard aims at ensuring safety for the construction and maintenance personnel of the Licensee from the hazards of electric shock, which may be caused in the Transmission System. The Transmission Licensee shall prepare his own Safety Manuals based on this Standard for his internal use. The Safety Manual shall be prepared in such a way that all the required aspects and safety procedures to be followed are covered in a complete manner without inviting reference to any other Codes or Standards. The details of working zones and the necessary isolations required for working on each equipment/line shall be clearly furnished in these Safety Manuals. A few typical illustrations are shown in the Annexe for guidance. The Safety Manual shall also lay down foolproof procedure in line with Section 11 of the Grid Code for issue of necessary permits and clearances (hereinafter called as “Line Clear Permit” or LCP) to the Engineer-in-charge of construction and/or maintenance seeking such permits. The designated employees for each Transmission Line and Substation authorized to issue and receive such permits shall be notified from time to time.

Reporting of Accidents
Every case where a person receives an electric shock, whether mild or serious or suffers an injury or burn, directly or indirectly due to electrical causes shall be treated as an “electrical accident”. The concerned jurisdictional engineer of the Transmission Licensee shall report the same immediately to the Deputy Electrical Inspector in charge of the area within 24 hours. A copy shall also be sent to the Chief Electrical Inspector to the Government of Karnataka. The
Deputy Electrical Inspector shall reach the spot immediately and assess the situation and probable cause of the accident, losses if any to consumers, and the equipment of the Transmission Licensee. This shall be followed by a detailed report within 48 hours whenever an accident occurs resulting in or likely to have resulted in loss of life of a human being.

An enquiry shall be conducted into every electrical accident. It shall be completed with the least possible delay, in any case not exceeding fifteen days, to guard against the possibility of destruction or disappearance of material evidence being presented, to escape responsibility. It shall be a searching probe to uncover the root causes of the accident, which sometimes are quite difficult to ascertain. The enquiry shall not only fix responsibility for the accident, but it is more important, to spell out steps to be taken to prevent recurrence of such accidents in future.

This Standard consists of three Sections as follows:

Section 1: General conditions and Grounding for protection of employees.

Section 2: Safety of employees in construction and maintenance works in Transmission Lines.

Section 3: Safety to workmen in energized sub-stations.
SECTION 1

GENERAL PRECAUTIONS AND GROUNDING FOR THE PROTECTION OF EMPLOYEES DURING MAINTENANCE WORKS UNDER LINE CLEARANCE PERMIT

1.1 All the conductors and equipment in the vicinity of a working zone that do not fall in the safe working zone permitted by the Line Clearance Permit, shall be treated as energized. The workmen shall not be permitted to commence work until the engineer in charge of the work ascertains that the equipments and conductors are tested or otherwise determined to be de-energized and grounded. The engineer in charge shall ascertain the following conditions before permitting the workmen to commence work:

a) The Lines or equipment are grounded,

b) Any hazards of induced voltages are not present,

c) Adequate clearances or other means are implemented to prevent contact with energized Lines or equipment, and with the new Lines or equipment.

1.2 Bare wires of communication conductors if any, on power Lines or structures, which are not protected by insulating materials shall be treated as energized.

1.3 Before grounding the de-energized conductors and equipment, the same shall be tested for voltage.

1.4 The following procedure shall be adopted for de-energizing Lines and equipment in cases where the means of disconnection from electricity supply is not visibly open:
a) The Particular section of Line or equipment to be de-energized shall be clearly identified, and isolated from all sources of voltage.

b) For each Transmission Line, the designated authority authorized to issue a work permit shall take the following precautions:

(1) The circuit breakers and switches through which there is a possibility of supply of electrical energy to the particular section of the Line or equipment to be worked upon shall be kept open.

(2) Caution Boards indicating "Men at Work" shall be fixed to all the above circuit breakers and switches.

(3) Wherever the design of such circuit breakers and switches permit automatic operation, or operation from a remote place, the same shall be rendered inoperable.

c) After all the required circuit breakers and switches have been opened, and rendered inoperable, visual inspection or tests shall be conducted to ensure that the equipment or Lines have been de-energized.

d) Protective grounds shall be provided to the disconnected Lines or equipment to be worked on. If there is any grounding switch, the same shall be closed.

e) Guards or barriers shall be erected wherever found necessary to the adjacent energized Lines.

f) When more than one independent crew require the Line Clear or Work Permit for the same Line or equipment, the designated employee in charge shall place a prominent "WORK IN PROGRESS" board on the Line or equipment for each such independent crew.

1.5 On completion of work on de-energized Lines or equipment, each crew in charge shall determine the following:

(i) All the employees in his crew are clear off the work site and accounted for,

(ii) The protective grounds installed by his crew have been removed,
Only after ascertaining the above, the crew in charge shall report to the holder of LCP that all tags demarcating the work area may be removed.

1.6 When attaching grounds, the ground end shall be attached first, and then the other end shall be attached to the equipment or Line by means of insulated tools or other suitable devices.

1.7 Similarly while removing the grounds after completion of work, the attachment at the conductor or Line end shall be removed by means of insulated tools or other devices before the ground is removed.

1.8 Ground electrodes shall be placed as close as practicable to the work location, preferably at the work location itself. If work is to be performed at more than one location in the Line section, the Line section must be grounded and short-circuited at one location in the Line section and the conductor to be worked on shall be grounded at each work location.

1.9 The following minimum clearances (Section Clearance and Ground Clearance) from the ungrounded conductors and equipment shall be maintained for the working personnel who may be required to stand for carrying out the work, at the work location:

**SAFETY CLEARANCES TO ENABLE OPERATION, INSPECTION, CLEANING, REPAIRS, PAINTING AND NORMAL MAINTENANCE WORK TO BE CARRIED OUT**

<table>
<thead>
<tr>
<th>Rated voltage</th>
<th>Minimum clearance from any point on or about the equipment where a man may be required to stand (measured from the position of the feet)</th>
</tr>
</thead>
</table>
To the nearest unscreened live conductor in air
SECTION CLEARANCE (SC) Mtr

<table>
<thead>
<tr>
<th>KV</th>
<th>To the nearest point not at earth potential of an insulator supporting a live conductor</th>
<th>GROUND CLEARANCE (GC) Mtr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 11</td>
<td>2.59</td>
<td>2.44</td>
</tr>
<tr>
<td>33</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>3.50</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>4.00</td>
<td></td>
</tr>
<tr>
<td>220</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>400</td>
<td>6.50</td>
<td></td>
</tr>
</tbody>
</table>

A typical sketch illustrating the safe working zones for which the above clearances are applicable is shown in Figures 1 and 2 of the Annexe.

1.10 In some cases establishing a ground connection to any equipment may become impracticable or the conditions resulting therefrom would be more hazardous. In such cases working on Lines or equipment without grounding such equipment may be permitted and the ungrounded Line or equipment shall be treated as energized for working purposes even though they may have been disconnected from the source of electric supply.

1.11 Grounds may be temporarily removed only when necessary for test purposes and extreme caution shall be exercised during the test procedures.

1.12 The ground electrodes shall have a resistance to ground as low as possible so that they may not cause any danger or harm to the working personnel due to induced voltages. In case of any accidental contact with the live conductors, either the voltage rise shall be too
small to cause any shock hazards or the same shall result in the isolation of the circuit causing the voltage rise by fast acting relays.

1.13 The minimum size of ground lead shall be 70 sq.mm. PVC insulated aluminum or 2 SWG copper. The earth electrodes for temporary earths shall be of mild steel rods of at least 20-mm diameter and 1524 mm length. These shall have clean metal surfaces, free from rust or any coating of paint or other poor conducting material and be driven to a depth of at least one meter in a spot considered to give good earth. The earth leads shall be connected to the ground rod using an appropriate crimped terminal for the lead and through suitable bolts and nuts to the ground rod.
SECTION 2
SAFETY OF EMPLOYEES IN CONSTRUCTION AND MAINTENANCE WORKS IN TRANSMISSION LINES

2.1 The excavation for pad or pile type foundations in excess of 1.5-mtr. depth located on unstable earth, shall be either sloped to the angle of repose or shored if entry is required. Ladders shall be provided for access to pad or pile type-footing excavations in excess of 1.2 mtr.

2.2 Wherever the foundation is being constructed on unstable earth, the workmen shall not be permitted to enter the excavated pit unless shoring is used to protect them.

2.3 Only responsible and skilled employees shall be deployed for directing mobile equipment adjacent to footing excavations.

2.4 No workmen shall be permitted to remain in the excavated pit where concreting is done using machinery.

2.5 The mobile equipment shall be located only on leveled earth to assure stability.

2.6 Sufficient care shall be taken during tower erection to see that more than the minimum number of workmen is not deployed. This will minimize exposure of falling objects on workmen, when working at two or more levels. Proper protection such as use of helmets, safety belts etc., shall be insisted upon.
2.7 Tie ropes shall be used wherever necessary for maintaining steel sections or other parts in position to reduce the possibility of tilting etc.

2.8 Adequate supports shall be provided for the tower members and sections of panels during assembly.

2.9 The construction of Transmission towers, erection of poles, the tools and machinery employed for the work shall meet the requirements of the relevant Indian Standard Specifications and Code of Practices along with the CBIP manual on Transmission Lines. The wire ropes, pulley blocks etc., shall be of tested quality and inspected by a responsible employee for its fitness before commencing the work.

2.10 Other than the supervisory staff and such of the workmen required to guide and assist the section being erected, no one else shall be permitted to come under a tower being erected.

2.11 During erection of towers using hoisting equipment adjacent to existing Transmission Lines, the Lines shall be de-energized wherever possible. When this is not practicable, extraordinary precautions shall be exercised to maintain the minimum clearances required including those mentioned in clause 1.9.

2.12 Wherever cranes are used for erection, the same shall be set on firm foundations. The outriggers of the cranes shall be used
wherever available. The wheels shall be locked in position to prevent dislocation during handling.

2.13 Suitable tie ropes shall be used to maintain control of tower sections being raised and positioned wherever possible and proper care shall be taken to see that they do not create a greater hazard. The wire rope used for carrying the section shall not be detached before the section is adequately secured.

2.14 The erection or maintenance work shall not be carried out during high wind, thunderstorms or heavy rainfall, which would make the work hazardous, except during emergency restoration procedures.

2.15 The engineer in charge shall regularly maintain all the equipment and tools and plant in safe operating conditions.

2.16 Adequate traffic control shall be maintained wherever erection work is being carried out at highway crossings. The permissions required from the concerned authorities, such as the department of highway, police etc., shall be obtained prior to commencement of work. Similarly, for erection work at railway crossings, the permission of the railway authorities shall be obtained before commencing the work.
2.17 The engineer in charge shall ensure the required clearances to be maintained in moving equipment under or near the energized Lines.

2.18 Before commencing the stringing operations or removal of conductors, a briefing shall be held by the supervisor with the workmen setting forth the following:
   a. Plan of operation,
   b. The type of equipment and tools and plant to be used,
   c. Grounding devices and procedures to be followed,
   d. Crossover methods to be employed, and
   e. The clearance authorization required.

2.19 Wherever there is a possibility of the conductor being handled coming in contact with an energized conductor, or there is a possibility of a dangerous voltage buildup due to induction, the conductor being handled shall be grounded, unless a provision is made to insulate or isolate the employee. If the existing Line is de-energized, a Line Clear Permit shall be obtained and the Line grounded on both sides of the cross over. In case the Line Clearance Permit cannot be obtained the Line shall be considered as energized for all practical purposes.

2.20 While executing the work of crossing over an existing Line, suitable guard structures with rope nets shall be installed to isolate the conductors and workmen coming within the required minimum clearances specified for the voltage. If there is any auto reclosure installed on the energized Line, the same shall be made inoperative. In addition the Line being handled shall be grounded on either side of the cross over.
2.21 The conductors being strung or removed shall be kept under control by using adequate reels, guard structures, tie lines, or any other appropriate means to prevent accidental contact with energized wires.

2.22 The guard structure shall have sufficient strength and have adequate dimensions and supported adequately.

2.23 The wire ropes, come-along clamps, anchors, guys, hoists shall have ample capacity to prevent failure and accidents. The load rating specified by the manufacturers for stringing equipment, pulley blocks and all other load bearing hardware and tools shall not be exceeded during operations. These shall be inspected regularly and replaced and repaired when damaged or when dependability is doubtful.

2.24 Come-along clamps designed for the specific conductor range only shall be used. During stringing or removal of conductors, no workmen shall be permitted to come directly under overhead operations, or on the cross arms. The dead end points of the conductors at section towers shall be adequately anchored before commencing operations. The grounds provided to the conductor shall be maintained intact until the conductors are hooked on to the insulators.

2.25 The reel handling equipment, including pulling and braking machines shall have ample capacity, operate smoothly, and leveled and aligned in accordance with the manufacturer's
operating instructions. Reliable communication between the operator of these machinery and the stringing operators shall be provided.

2.26 Each conductor shall be dead-ended at both ends before commencing stringing of the conductor in the next section.

2.27 The sequence of stringing of conductors and ground wires shall strictly follow the design conditions of erection loads considered for the structure. The method of erection followed shall not impose loads in excess of design loads on the structure.

2.28 Before commencing the stringing or releasing operations of any conductor adjacent to an energized Line, the following precautions, in addition to all the above, shall be taken:

a. Only skilled and trained labourers competent to work on Transmission Line Construction shall be deployed for the work. The workmen should be in good health and able bodied.

b. The possibility of dangerous voltages due to induction, particularly during switching and fault conditions, shall be investigated.

c. The tension stringing method or such other methods, which preclude unintentional contact between the Lines being pulled and the employee, shall only be used.

d. All the pulling and tensioning equipment shall be isolated, insulated, or effectively grounded.

e. A ground rod shall be installed between the tensioning reel setup, and the first structure in order to ground each bare
conductor, sub-conductor, or overhead ground wire during stringing operations.

f. During stringing or unstringing operations, each conductor or ground wire shall be grounded at the first tower adjacent to both the tensioning and pulling setup and in increments so that no point is more than 3 Kms. apart.

g. The grounds shall be left in place till the conductor installation is completed.

h. These grounds shall be removed at the last phase of cleanup operations.

i. The grounds shall be placed or removed only with a Hot Stick.

j. Conductors and ground wires shall be grounded at all dead-end points.

k. A ground shall be located at each side and within 10 feet of working areas where conductors, or ground wire are being jointed at ground level. The two ends to be jointed shall be bonded to each other. The jointing shall be carried out on either an insulated platform or on a conductive metallic grounding mat bonded to grounds. When grounding mat is used, the same shall be barricaded and an insulated walkway provided for access to the mat.

l. All the conductors and ground wire shall be bonded to the end tower where the work is to be completed. At the dead-end tower, the de-energized Line shall be grounded.

m. The grounds can be removed on completion of the work making sure that the Line is not left open circuited at any tower at which the work is carried out.

2.29 The following precautions shall be taken for Hot-Line bare hand work in addition to all other applicable precautions specified in these Standards:
a. Only qualified and trained employees, trained for Hot-Line bare-hand technique and the pertinent safety requirements thereto, shall be permitted for the work.

b. The following checks shall be made before commencing Hot-Line bare-hand work on energized high-voltage conductors or equipment:

   i. The voltage rating of the circuit on which the work is to be carried out.

   ii. The clearances to ground of the Lines and other energized parts on which work is to be carried out.

   iii. The voltage limitations of the aerial-lift equipment intended to be used.

c. The Hot Line equipment to be used shall be of proper design and tested.

d. Only a person trained and qualified to carry out Hot-Line bare-hand work shall supervise the work.

e. If any automatic reclosing feature is available on the circuit breakers or switches, the same shall be made inoperative before commencing the work on any energized Line or equipment.

f. The work shall not be carried out during thunderstorms.

g. A conducting Bucket Liner or any other suitable conducting device shall be provided for bonding the insulated aerial device to the energized Line or equipment.

h. The employee shall be connected to the Bucket Liner through conducting shoes, leg clips or by any other suitable means.

i. Adequate electrostatic shielding for the rated voltage of the Line or equipment on which work is being carried out shall be
provided to the workmen wherever necessary or conducting
clothing shall be provided.

j. Only tools and plant intended for hot-Line bare-hand work
shall be used, and these shall be kept clean and dry.

k. The outriggers on the aerial truck shall be extended and
adjusted to stabilize the body of the truck before the boom is
elevated. The body of the truck shall be bonded to an
effective ground, or barricaded and considered as energized
equipment for all purposes.

l. All the controls at ground level and Bucket available in the
truck shall be checked and tested to determine their proper
working condition before moving.

m. Every day, and each time, before commencing the work
"arm current tests" shall be carried out. Aerial Buckets used
for hot-Line bare-hand work shall also be subjected to these
tests. This test shall be carried out by placing the Bucket in
contact with an energized source equal to the voltage to be
worked upon for a minimum period of three (3) minutes and
the leakage current shall not exceed one (1) microampere
per kilo-volt of nominal Line-to-Line voltage. The work shall be
suspended immediately if any indication of a malfunction in
the equipment is noticed.

n. All the aerial lifts shall have dual controls (lower and upper) as
follows:

i. The upper control shall be within easy reach of the
employee in the basket. If a two-basket type lift is used,
access to the controls shall be within easy reach from
either basket.

ii. The lower set of controls shall be located near the base of
the boom that will permit over-ride operation of the
equipment at any time.
o. Ground level lift control shall not be operated without the permission of the employee in the lift, except in case of emergency.

p. The conducting Bucket Liner shall be bonded to the energized conductor by means of a reliable connection before the employee contacts the energized part. This shall remain attached to the energized conductor until the work is completed.

q. The following minimum clearance shall be maintained from all grounded objects and from Lines and equipment at a different voltage than, to which the insulated aerial device is bonded, unless such grounded insulated guards cover objects or other Lines and equipment. These distances shall be maintained when approaching, leaving, and when bonded to the energized circuit.

**MINIMUM CLEARANCES FOR HOT-LINE BARE-HAND WORK**

<table>
<thead>
<tr>
<th>Voltage range (Phase-to-phase)</th>
<th>Distance in meters for maximum voltage</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Phase to ground</td>
<td>Phase to phase</td>
</tr>
<tr>
<td>11 KV</td>
<td>0.61</td>
<td>0.61</td>
</tr>
<tr>
<td>33 KV</td>
<td>0.72</td>
<td>0.72</td>
</tr>
<tr>
<td>66 KV</td>
<td>0.92</td>
<td>0.92</td>
</tr>
<tr>
<td>110 KV</td>
<td>1.02</td>
<td>1.38</td>
</tr>
<tr>
<td>220 KV</td>
<td>1.53</td>
<td>2.54</td>
</tr>
<tr>
<td>400 KV</td>
<td>3.35</td>
<td>6.10</td>
</tr>
</tbody>
</table>

r. The above minimum distances shall be maintained between all parts of the insulated boom assembly and any grounded parts including the lower arm or portions of the truck, while approaching, leaving or bonding to an energized circuit.
s. The above table shall be printed on a plate of durable non-conducting material, mounted in the Buckets or its vicinity in such a position that the same is clearly visible to the operator of the boom. Insulated measuring sticks only shall be used to verify the clearances.

t. During positioning the Bucket alongside an energized bushing or an insulator string, the minimum Line-to-ground clearances indicated in the above table must be maintained.

u. The use of Handlines between Buckets, booms, and ground is prohibited.

v. No conducting material longer than 0.9 meter, other than the jumpers of appropriate length, armor rods, and tools shall be placed in the Bucket.

w. Non-conductive type Handlines may be used from Line to ground only when the same is not supported from the Bucket.

x. The Bucket and the upper insulated boom shall not be overstressed by attempting to lift or support weights in excess of the manufacturer's rating.

2.30 Notwithstanding all the above, the recommendations of the manufacturer of the Hot-Line equipment being used shall be strictly followed.
SECTION 3
SAFETY TO WORKMEN IN ENERGIZED SUBSTATIONS

3.1 For carrying out the construction or maintenance work in an energized Substation, appropriate authorization and the Line Clearance Permits shall be obtained from the designated, authorized person before work is started.

3.2 Before commencing the work, the protective equipment shall be checked for satisfactory performance and precautions necessary for the safety of the personnel shall be ensured.

3.3 Extraordinary caution shall be exercised in handling busbars, structures, and equipment in the vicinity of the energized facilities.

3.4 No employee shall be permitted to approach or take any conductive object without a suitable insulating handle closer to exposed energized parts than shown in the table below:

<table>
<thead>
<tr>
<th>Nominal Voltage Range (KV)</th>
<th>Minimum Working distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>0.60 mtr</td>
</tr>
<tr>
<td>33</td>
<td>0.75 mtr</td>
</tr>
<tr>
<td>66</td>
<td>0.91 mtr</td>
</tr>
<tr>
<td>110</td>
<td>1.02 mtr</td>
</tr>
<tr>
<td>220</td>
<td>1.53 mtr</td>
</tr>
<tr>
<td>400</td>
<td>3.35 mtr</td>
</tr>
</tbody>
</table>

3.5 The minimum working distance stated in the above table shall not be normally violated. These clearances can be curtailed only under the following conditions:
a. The employee is insulated or guarded from the energized part\(^1\)
Or
b. The energized part insulated or guarded from him and other conductive object is at a different potential,
Or
c. The employee is isolated, insulated, or guarded from any other conductive object(s), as during Hot-Line bare handwork.

3.6 When it is necessary to de-energize the equipment or Lines for protection of employees, the requirements of Clause.4 shall be complied with.

3.7 Barricades or barriers shall be installed to prevent accidental contact with energized Lines or equipment. Where appropriate, signs indicating the hazard shall be displayed near the barricade or barrier.

3.8 Only designated employees shall be permitted to work on equipment under LCP or adjacent control panels and precaution shall be taken to avoid accidental operation of relays or other protective devices due to jamming, vibration, or improper wiring.

3.9 Designated employees shall at all times control the use of vehicles, gin poles, cranes, and other equipment in restricted and hazardous areas.

3.10 All mobile cranes and derricks shall be effectively grounded when being moved or operated in close proximity with energized Lines or equipment. If this is not possible, the equipment shall be considered energized.

3.11 When a Substation fence must be expanded or removed for construction purposes, a temporary fence affording similar protection when the site is unattended, shall be provided. Adequate interconnection with ground shall be maintained between temporary and permanent fences.

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\(^1\) Gloves or gloves with sleeves for the rated voltage involved shall be considered insulation to the employee from the energized part.
3.12 All gates in all the unattended Substations shall be locked when the work is in progress.
DISTRIBUTION CODE
1.1 General

1.1.1 The Retail Supply License issued by KERC for any Company requires the Licensee to formulate a "Distribution Code" for planning, construction, operation and maintenance of the Distribution System to be duly approved by the Karnataka Electricity Regulatory Commission (KERC). 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 in the planning and development of the Distribution & Retail Supply Licensee's Distribution System; and

(b) Distribution Operation Code containing the conditions under which the Distribution & Retail Supply Licensee shall operate his Distribution System. This code also specifies the requirements necessary to maintain the quality, security and safe operation of the system under normal and abnormal conditions.

1.1.1 The Karnataka Electricity Regulatory Commission in exercise of the powers conferred on it by Sections 11(j) and 56 of the KARNATAKA ELECTRICITY REFORM ACT, 1999 has issued "Electricity Supply and Distribution Code, 2000-01". This covers the distribution and supply of electricity and procedures thereof such as the powers, functions and obligations of the Licensees and the rights and obligations of the consumers and all incidental matters connected therewith.

1.1.2 This "Distribution Code", hereinafter referred to as the Code covers the following:

i. Distribution Planning Code,
The Code also covers all the technical and operational aspects pertaining to planning and development of the Distribution & 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) are also covered in this Code.

1.1.3 The provisions of this Code are common to all the Distribution & Retail Supply Licensees except in cases of specific deviations/departures or approvals made to an individual Licensee by KERC.

1.2 **Scope**

1.2.1 The provisions of this code shall be applicable to the Distribution & Retail Supply Licensee and to all the specific Users of the Licensee's Distribution System excepting for any exemptions granted in writing by KERC.

1.2.2 Further, the Distribution & Retail Supply Licensee and the consumers seeking connection with the Distribution System shall comply with the “Electricity Supply and Distribution Code, 2000 - 01”.

1.3 **Implementation and Review of the Distribution Code**

1.3.1 The Distribution & Retail Supply Licensees shall periodically review this Code and its implementation, as and when necessity arises. For this purpose a Review Panel, hereinafter called Panel, shall be established. The Panel shall consist of the following members:

a. A Chairman, on rotation basis, from each Distribution & Retail Supply licensee;

b. One member from each of the Distribution & Retail Supply Licensees;

c. One member from the Transmission Licensee;
d. One member each from the Generating Stations directly connected to each of the Distribution & Retail Supply Licensee’s Distribution System to represent all the Generating Stations,

e. One member to represent consumers to be nominated by KERC.

1.3.2 The Panel shall frame, with the approval of KERC, its own Rules and procedures for conducting its business, including appointment and tenure of the Chairman, Convener and Secretary, a standing Secretariat and appropriate funding arrangements for the Panel.

1.3.3 The Panel shall meet at least once in three months.

1.3.4 The Panel shall carry out the following functions:


   b. Review of all the suggestions for amendments to this Code made by any of the Distribution & Retail Supply Licensees or other members and also KERC;

   c. Issue of guidelines in relation to this Code, and its implementation, interpretation of any provision thereunder at the request of any person connected to the Distribution & Retail Supply Licensee’s Distribution System;

   d. Consider changes necessary in this Code arising out of any unforeseen circumstances.

   e. Review the causes of electrical accidents, if any, and remedial measures to avoid recurrence of such accidents.

1.3.5 Following 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

   b. Any proposed revision or revisions the Panel may reasonably think fit for achieving the objectives of this Code;

   c. All the written representations or objections from any member of the Panel whose views were not accepted by the Panel.
1.4 **Unforeseen Circumstances**

1.4.1 In the event any circumstance not envisaged in the provisions of this Code arises, the Distribution & Retail Supply 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 & Retail Supply 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 & Retail Supply Licensee. The concerned Distribution & Retail Supply Licensee shall however refer all such cases for consideration in the next meeting of the Panel.

1.5 **Non-Compliance**

1.5.1 The Licence requires the Distribution & Retail Supply Licensee to comply with the provisions of this Code. The Users are required to comply with the provisions of this Code pertaining to them. Any User or Distribution & Retail Supply Licensee to whom the provisions of this Code apply, and for any reason unable to comply with the same, shall promptly refer the matter to KERC, justifying his actions. The KERC may grant exemption depending upon the merits of such matter. Non-Compliance with the provisions of this Code without justifiable reasons meriting exemption shall constitute an offence under the Act.
# SECTION 2

## DEFINITIONS

In the Distribution Code the following words and expressions shall, unless the subject matter or context otherwise requires or is inconsistent therewith, bear the following meanings:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Act</td>
<td>The Karnataka Electricity Reform Act, 1999</td>
</tr>
<tr>
<td>Active Power</td>
<td>The product of voltage and the in-phase component of alternating current measured in units of watts and standard multiples thereof, i.e., 1000 Watts = 1 KW 1000 KW = 1 MW</td>
</tr>
<tr>
<td>Agreement</td>
<td>An Agreement entered into by the Licensee and the User.</td>
</tr>
<tr>
<td>Apparatus</td>
<td>All the Electrical Apparatus, including machines, fittings, accessories and appliances in which conductors are used.</td>
</tr>
<tr>
<td>Apparent Power</td>
<td>The product of voltage and current of an alternating current system measured in units of volt-amperes and standard multiples thereof, i.e., 1000 VA = 1 kVA 1000 kVA = 1 MVA</td>
</tr>
<tr>
<td>Area of Supply</td>
<td>The area within which a Licensee is authorized by his License to supply Electricity at the time.</td>
</tr>
<tr>
<td>Bare conductor</td>
<td>Conductor not covered with insulation.</td>
</tr>
<tr>
<td>Breakdown</td>
<td>An occurrence relating to an equipment of the supply system or line, which prevents normal functioning.</td>
</tr>
<tr>
<td>Cable</td>
<td>A length of conductor provided with insulation. The same may or may not be provided with an overall mechanical covering.</td>
</tr>
<tr>
<td>Circuit</td>
<td>Arrangement of conductor(s) for the purpose of carrying electrical energy and forming a system or branched system.</td>
</tr>
<tr>
<td>COINCIDENCE FACTOR</td>
<td>Ratio of combined peak loads of a group of connected loads to the sum of peak loads of the individual connected loads.</td>
</tr>
<tr>
<td>Conductor</td>
<td>Any Wire, cable, Bar, Tube, Plate, etc., used for conducting energy and electrically connected to the system.</td>
</tr>
<tr>
<td>Connected Load</td>
<td>Aggregate of manufacturer’s rating of all the connected Apparatus, including portable Apparatus, in the consumer’s premises. It includes all Apparatus for which the Consumer has made declaration, for taking supply. 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. 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.</td>
</tr>
<tr>
<td><strong>POINT</strong>/ <strong>CONNECTION POINT/ INTERCONNECTION</strong></td>
<td>A point at which a User's electrical system is connected to the Licensee's Distribution System.</td>
</tr>
<tr>
<td><strong>Contract Demand</strong></td>
<td>Maximum KW or KVA agreed to be supplied by the Licensee and indicated in the agreement executed between the parties. Wherever the agreement stipulates supply in KVA, the quantum in terms of KW may be obtained by multiplying by the Power Factor of 0.85.</td>
</tr>
<tr>
<td><strong>Control Person</strong></td>
<td>The person designated by the Distribution &amp; Retail Supply Licensee and any User having common electrical interface with the Distribution &amp; Retail Supply Licensee's Distribution System, responsible for safety coordination.</td>
</tr>
<tr>
<td><strong>DISTRIBUTION SYSTEM</strong></td>
<td>&quot;Distribution System&quot; means any system consisting mainly of cables, service lines and overhead lines, electrical plant and meters having design voltage of 33 KV and below. The distribution system shall not include any part of a transmission system except the terminal equipment used for the supply of electricity to extra high voltage (66 KV and above) consumers.</td>
</tr>
<tr>
<td><strong>DIVERSITY FACTOR</strong></td>
<td>Ratio of the sum of peaks of group of connected loads to the combined peak load of the group.</td>
</tr>
<tr>
<td><strong>ESCOM</strong></td>
<td>Electricity Supply Company holding Distribution and Retail Supply License.</td>
</tr>
<tr>
<td><strong>Grid Code</strong></td>
<td>Karnataka Electricity Grid Code approved by KERC.</td>
</tr>
<tr>
<td><strong>High Tension (HT)</strong></td>
<td>System or supply energized at 650 volts or above up to 33,000 volts.</td>
</tr>
<tr>
<td><strong>KERC</strong></td>
<td>Karnataka Electricity Regulatory Commission.</td>
</tr>
<tr>
<td><strong>KPTCL</strong></td>
<td>Karnataka Power Transmission Corporation Limited.</td>
</tr>
<tr>
<td><strong>Load Factor</strong></td>
<td>Ratio of average load to peak load over a designated period.</td>
</tr>
<tr>
<td><strong>Low Tension (LT)</strong></td>
<td>System or supply energized at 415 Volts three phase or 240 Volts single phase.</td>
</tr>
<tr>
<td><strong>Power Factor</strong></td>
<td>Ratio of Active Power to Apparent Power i.e. KW to KVA.</td>
</tr>
<tr>
<td><strong>SLDC</strong></td>
<td>State Load Dispatch Centre.</td>
</tr>
<tr>
<td><strong>TRANSMISSION SYSTEM</strong></td>
<td>The System consisting of extra high voltage lines and stations, having design voltage of 66 KV and above owned or operated by a Transmission Licensee for transmission of electrical power from the generating station bus bars up to the interconnection point with the distribution system. This shall not include any part of the Distribution System.</td>
</tr>
<tr>
<td><strong>User</strong></td>
<td>Any person having electrical interface with, or using the Distribution System of the Distribution &amp; Retail Supply Licensee to whom this Code is applicable. Any other Distribution &amp;</td>
</tr>
</tbody>
</table>
Retail Supply Licensee, Transmission Licensee and generating units connected to the Distribution system are also included in this term.

The words or expressions occurring in this Code but not defined above shall have the same meaning as in the Karnataka Electricity Reform Act, 1999; or Indian Electricity Act, 1910; or the Electricity (Supply) Act, 1948; or in the Rules and Regulations framed under the said Acts. In the absence thereof, the meaning commonly understood in the electricity industry shall be applicable.

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SECTION 3
DISTRIBUTION PLANNING CODE

3.1 Scope

3.1.1 The Distribution Planning Code specifies the technical and design criteria and procedures to be followed by the Distribution & Retail Supply Licensee 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 Licensee to seek the extension or reinforcement to the capacity of the Transmission System at the connection 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 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 for the required time to obtain the required statutory clearances and consents or way leaves, and the detailed engineering, design and construction work to be carried out and completed. The management techniques such as PERT and CPM shall be implemented allowing for sufficient slack time for critical activities, 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,
   - ii. Distribution System Construction, Operation and Maintenance Standard,
   - iii. Safety Standard for the Distribution System,
   - iv. Statutory Acts and Rules such as IE Act, IE Rules etc.
   - v. Relevant Indian Standard Specifications,
   - vi. REC Construction Standards and manuals.

(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 & Retail Supply 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 & Retail Supply Licensee and the Users,

(e) To provide the required information to the Users for connection, planning and development of their own systems and make them compatible with the Distribution System,

(f) To enable the Distribution & Retail Supply Licensee to co-operate with the Transmission Licensee in furnishing the required data as detailed in the Grid Code under the section "System Planning".

3.3 **Load Data**

3.3.1 The Distribution & Retail Supply Licensee shall develop load curves for the area fed by the concerned substation of the Transmission Licensee from the metering data available at the connection point. These data
shall be compiled for the entire Area of Supply combining the load curves of each substation 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 Transmission Licensee and KERC every month.

3.3.3 All the Users with Demands of 5 MW and above seeking connection shall furnish their load data to the Distribution & Retail Supply Licensee as detailed in Annexe 1. The Distribution & Retail Supply Licensee shall exercise special care to monitor the actual development of loads in respect of consumers desiring to avail loads of 5 MW and above at a single point. The Distribution & Retail Supply Licensee on his part shall furnish relevant System data as detailed in Annexe 2, if required by the User seeking connection to his Distribution System. The Distribution & Retail Supply Licensee shall update the System data regularly and at least once a year.

3.4 Forecast Methodology
3.4.1 The Distribution & Retail Supply Licensee shall formulate a long-term demand forecast considering the previous financial year as base and projecting the Demand for the succeeding 5 years. During this process he shall review the status of loads materializing as per the previous load forecast.

3.4.2 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.

3.4.3 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, and energy conservation.

3.4.4 The aggregate energy and peak load requirements at each connection point shall be estimated taking into account the distribution losses.

3.4.5 The Distribution & Retail Supply Licensee shall forward the long term demand forecast for each connection point with the Transmission System for his area of supply on annual basis to the Transmission Licensee and KERC 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 & Retail Supply Licensees to fully co-operate with the Transmission Licensee in preparation of demand forecasts for the entire Karnataka State.

3.5 Technical and Design Criteria:
   The Distribution & Retail Supply Licensee shall plan and develop his Distribution System on the basis of the following technical and design criteria:

3.5.1 The load demand of all the existing Users connected to it and all Users seeking connection with it shall be met. All the Apparatus and Circuits shall have adequate capacity to cater to their needs of electricity in a safe, economical and reliable manner.

3.5.2 The Distribution & Retail Supply Licensee shall assess and forecast the load demand of each category of consumers in his area of supply on annual basis or more frequently as required by the KERC.
3.5.3 The Distribution & Retail Supply Licensee shall have a thorough knowledge of the usage of electricity by the consumers and the way they use electrical energy and other alternative sources of energy in his area. 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.

3.5.4 The Distribution & Retail Supply 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 classes:

(a) Domestic sector,
(b) Commercial sector,
(c) Agricultural sector,
(d) Industrial sector

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 techniques to match the availability from time to time.

3.5.5 The load research program shall assess the following:

i. Demand at the time of system peak, daily, monthly, seasonal or annual,
ii. Hourly demand for the day of the system peak, monthly, seasonal or annual,
iii. Category wise Diversity Factor or the Coincidence Factor and Load Factor,
iv. Total energy consumption for each category by day, month, season or year,
v. Category wise non-coincident peak demand.

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

3.5.7 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 Standards for Distribution System issued separately. These standards form an integral part of this Code.

3.5.8 As far as practicable, separate circuits shall be provided for the following:
i. Urban non-industrial power supply,
ii. Urban industrial power supply,
iii. Rural Supply.

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

3.5.10 Load Flow and other system studies shall be conducted to locate the position of 33 / 11 KV substations, capacitor installations, distribution transformers, and to contain voltage variation and energy losses within reasonable limits.

3.5.11 The following parameters of equipments and system designs shall be standardized to facilitate easy replacement and reduction of inventories of spares in stores:
(a) Capacities of Power Transformers,
(b) Capacities and designs of Distribution Transformers,
(c) 33 KV substation Layouts,
(d) Pole mounted substations,
(e) Sizes of Bus bars,
(f) Capacities and ratings of Circuit breakers and Instrument Transformers,
(g) Earthing,
(h) Lightning Arresters,
(i) Control Panels,
(j) Station Batteries,
(k) Fire Extinguishers.

3.5.12 The planning of the Distribution System shall always keep in view the cost effectiveness and reduction in energy losses without sacrificing the requirements of Security Standards and Safety Standards for the Distribution System mentioned in clause 3.5.7.

3.5.13 The Distribution & Retail Supply Licensee shall plan the Distribution System expansion and reinforcement keeping the following in view along with all other measures to accommodate the advancement in technology prevailing at the time:

i. Economic Ratio of HT and LT line lengths,
ii. Use of Aerial Bunched Conductors,
iii. Underground Cables,
iv. Increasing the number of Distribution Transformers and their location at the electrical load centers.

3.6 Planning Procedure

3.6.1 The Distribution & Retail Supply Licensee shall forecast the Demand for power within his Area of Supply annually or more frequently as and when directed by KERC, for each succeeding 5 years.

3.6.2 The Distribution & Retail Supply Licensee shall create a database of loads for each consumer category and for each Distribution Substation connected to the Distribution System and update it on annual basis.

3.6.3 The Distribution & Retail Supply Licensee shall work out the details of the Load Research Program mentioned in clause 3.5.4 and file his proposal with KERC for its consideration.
3.7 **Energy Audit**

3.7.1 The Distribution & Retail Supply Licensee shall create responsibility centers for energy audit. Divisions, cities and towns with population of 50,000 and above, shall be made as responsibility centers and accountable for the energy sales and calculation of distribution losses. Load survey meters with a memory retaining capacity of at least 45 days shall be installed for all the incoming/outgoing feeders in the area identified for each such responsibility centre.

3.7.2 The Distribution & Retail Supply Licensee shall carry out energy audit of his total system compiling the data and analysis carried out in each responsibility centre. The energy received from each substation shall be measured at the 11 KV terminal switchgear of all the outgoing feeders installed with appropriate energy meters such that the energy supplied to the each division is accurately available. It shall be compared with the corresponding figures of monthly energy sales and the distribution loss for each division shall be worked out.
Annexe 1
LOAD DATA FOR DEMANDS OF 5 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 equipments 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.
Annexe 2

**SYSTEM DATA**
(Clause 3.3.3)

1. Topological map of Karnataka marking boundaries of Area of Supply of the Licensee
2. Distribution map of the Distribution & Retail Supply Licensee drawn to scale of not less than 1 cm to 2.5 KM showing the existing 11 KV and 33 KV lines and substations 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.
3. Single line diagram of the Distribution System showing line length, conductor sizes, substation capacity, capacitor sizes with locations, auto-reclosures etc.
4. Details of Metering and Relaying at 33/11 KV substations.
5. Details of Grid substations at the point of interconnections as follows:
   i. MVA Capacity and voltage,
   ii. Number of transformers, capacity of each transformer, voltage ratios, Ranges of taps, Impedance
   iii. Fault level at substation busbars, both three phase and single line to ground fault
   iv. Bus impedance,
   v. Substation layout diagram.
6. Drawal at interconnection points: Maximum and Minimum MW drawal from each interconnection with the Transmission System or with other Distribution & Retail Supply Licensees during last six months.
SECTION 4

DISTRIBUTION OPERATION CODE

4.1 Scope

4.1.1 This Section specifies the procedures and practices to be followed for a safe and efficient operation of the Distribution System by the Distribution & Retail Supply Licensee and by the Users of the Distribution System of their electrical plant and lines which are connected to the Distribution & Retail Supply Licensee’s Distribution System. This shall also apply to any electrical interface between two Retail Supply Licensees for a safe and efficient operation of the interface.

4.1.2 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 small Generating Plant including CPPs,
vi. Metering and Protection,
vii. Communication,
viii. Monitoring and control of Voltage, Frequency and Power Factor,
ix. Safety Co-ordination,
x. Major Incident and Accident reporting,
xi. Maintenance and Testing,
xii. Tools and Spares,
xiii. Training.

4.2 Demand Estimation

4.2.1 The Distribution & Retail Supply Licensee shall estimate his hourly and daily Demands at each point of interconnection on the basis of relevant Load Curves drawn on day-ahead basis subject to
modifications depending upon the communications received from any specific User or caused by any contingency.

4.2.2 For this purpose, the concerned major Users identified by the Distribution & Retail Supply Licensee shall furnish the required data pertaining to their Demands of their installations to him.

4.3 **Outage Planning**

4.3.1 The Distribution & Retail Supply Licensee shall furnish his proposed outage programs to the Transmission Licensee on a month-ahead basis.

4.3.2 The outage program shall 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 restricted at any interconnection point during outage.

4.3.3 The outage plan proposed by the Licensee shall come into effect only after the Transmission Licensee releases the finally agreed Transmission outage plan.

4.3.4 However at the time the Line or Equipment is taken out of service, the Distribution & Retail Supply Licensee shall intimate and obtain the consent of the designated officer of the Transmission Licensee for the same, even though the same is already included in the approved plan.

4.3.5 In case of Lines and Equipments of 66 KV and above the specific release of SLDC shall be obtained in addition to the above.

4.3.6 The above procedure shall not apply under the following circumstances:

i. In cases where the estimated drawal at interconnection points is not affected;
ii. Emergency situations to save plant and machinery;

iii. In such of the unforeseen emergency situations requiring isolation of Lines or Equipment to save human life,

iv. 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.

4.3.7 Planned outages of Power System for more than 10 hours for maintenance purposes shall be intimated to the public through media two days in advance.

4.4 Contingency Planning

4.4.1 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 breakdowns 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.

4.4.2 Transmission System Failure:

i. In case of a total blackout at any point of interconnection, the Distribution & Retail Supply Licensee shall follow the black start procedures framed by the Transmission Licensee as required in the Grid Code.

ii. The Distribution & Retail Supply Licensee shall sectionalize the Distribution System into discrete blocks of demand. He shall advise the SLDC of the amount of MW load likely to be picked up on switching each demand block.

iii. The Distribution & Retail Supply Licensee shall prepare a schedule of essential and non-essential loads in order of priority at each interconnection to be picked up during the restoration process.

iv. The Distribution & Retail Supply Licensee shall ensure and maintain the load generation balance under the direction of the SLDC.
The Distribution & Retail Supply Licensee shall maintain direct communication links with the SLDC till normalcy is restored.

The Distribution & Retail Supply Licensee shall furnish the names and designations of the person(s) with their telephone numbers and stations, authorized to deal with contingency operations, to the SLDC.

4.4.3 Distribution System Failure:

i. Interruptions to power supply in any part of the Distribution System lasting for more than two hours due to breakdown in any part of the Distribution System may be termed as a Distribution System Failure.

ii. The Distribution & Retail Supply Licensee shall evolve a restoration process for such a Distribution System Failure.

4.4.4 Failure of the Apparatus of the Transmission Licensee:

i. The Distribution & Retail Supply Licensee shall immediately contact the authorized person at the substation 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 & Retail Supply Licensee shall effect the Demand Side Management plan accordingly.

4.5 Demand Management and Load Shedding

4.5.1 Temporary Load Shedding may be resorted to 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.

4.5.2 The Distribution & Retail Supply Licensee 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. Such Users shall cooperate with the Licensee in this regard. The Distribution & Retail Supply Licensee shall work out the sequence of Load Shedding operations and the detailed procedure shall be furnished to the persons in-charge of substations 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 substations of the Distribution & Retail Supply Licensee as necessary.

4.5.3 If the duration of Load Shedding to any part of the Distribution System exceeds 60 minutes, the public should be intimated promptly through the media. The Consumers with Contract Demand of 1 MW and above and the essential services such as Hospital, Public Water Works etc. shall be intimated over the telephone wherever possible.

4.6 Interface with Small Generating Units including CPPs

4.6.1 If the Distribution & Retail Supply Licensee has an interface with any generating unit including CPP and an Agreement for this purpose exists, the Distribution & Retail Supply Licensee and the concerned owner of the generating unit shall abide by the following provisions in addition to the provisions contained in this Code as applicable to all the Users:

i. **Generating Units up to 3 MW:**
   a. The owner shall provide suitable protection at the interface to protect his system from any damage due to normal and abnormal conditions in the Distribution System.
   b. If the Generator is an Induction Generator, the owner shall install separate metering for the Reactive Load drawal, in addition to his operational metering.

ii. **Generating Units of 3 to 5 MW:**
   In addition to the above provisions applicable to the Generating Units up to 5 MW, the Generating Company shall comply with the provisions of the Grid Code also.
4.7 **Metering and Protection**

4.7.1 **Operational metering:**

The minimum requirement of Operational Metering at the Distribution System substations shall be as follows:

i. **33 KV/11 KV substations:**
   - 33 KV Bus Voltage
   - 11 KV Bus Voltage
   - 33 KV incoming/outgoing current in each phase and each circuit
   - Power Transformer Primary and Secondary Currents in each phase of every Transformer
   - 11 KV outgoing feeder currents in each phase for each feeder
   - Power Factor in each 11 KV feeder
   - Load survey meters having memory duration of at least 45 days for all the incoming and outgoing feeders (both 33 and 11 KV)

ii. **User’s system with Demand of 1 MW and above:**
   - Voltage
   - Current
   - Load
   - Power Factor

4.7.2 **Tariff and Commercial Metering:**

(a) Tariff metering shall be provided at each point of interconnection between the Distribution and Transmission Systems in accordance with the Grid Code and the Transmission Services Agreement.

(b) Tariff metering shall be provided at the connection points between the User’s System and the Distribution System and shall be governed by the provision in the Transmission Services Agreement.
(c) All the meters, metering cubicles and testing procedures shall conform to the relevant Indian Standard Specifications and Indian Electricity Rules, 1956.

4.7.3 Measurement of energy import/export:

(a) The Distribution & Retail Supply Licensees shall install the following meters for all of their sub-transmission lines connecting the generating stations, and substations for the measurement of energy import/export from each line, energy generated in generating units and energy consumed in power stations and substations:

- Active energy import.
- Active energy export.
- Reactive energy import.
- Reactive energy export.

(b) Each metering point associated with the determination of energy exported or imported, between the Generating Companies, Transmission Licensees Bulk Supply Licensees and Distribution & Retail Supply Licensees shall be provided with both main and check meters. The minimum standard of accuracy of these meters shall be of accuracy class 0.2. These meters shall conform to the relevant IEC or IS specifications.

(c) All the instrument transformers used in conjunction with commercial (tariff) metering shall also be of accuracy class 0.2 and conform to the relevant IEC or IS specifications. The rating shall be suitable for catering the burdens of lead wires and metering.

(d) Data collection shall be used to integrate impulses from meters over each integration period as per agreement, store values, and to transmit the same to the data collection system of the Distribution & Retail Supply Licensee. Data shall be collected from both the main and check metering schemes.

(e) Voltage failure relays shall be provided to initiate alarm on loss of one or more phases of the voltage supply to the meter.

(f) Main and check meters shall be provided at all interconnection points. All the meters shall be tested and calibrated according to the guidelines provided in the relevant IEC/IS specifications at least once a year and also whenever the difference in readings between the main and check meters exceed 0.5%.
(g) Records of these calibrations and tests shall be maintained for reference.

(h) The Generating Companies, Transmission Licensees, Bulk Supply Licensees and Distribution & Retail Supply Licensees shall formulate and agree upon a procedure covering summation, collection and processing of tariff meter readings at various interconnection sites of their area. Whenever necessary, these procedures can be revised.

(i) The ownership, responsibility of maintenance and testing of these meters shall be as mutually agreed to between the Users and the concerned Licensees.

4.7.4 Protection System:

(a) No item of electrical equipment shall be allowed to remain connected to the system unless it is covered by the appropriate protection aimed at reliability, selectivity, speed and sensitivity. The Distribution & Retail Supply Licensees shall cooperate with the Transmission Licensee to ensure correct and appropriate settings of protection to achieve effective, discriminatory isolation of faulty line/equipment within the time target clearance specified by the Transmission Licensee.

(b) Protection settings shall not be altered, or protection bypassed and/or disconnected without consultation and agreement of all the affected Users. In case the protection has been bypassed and/or disconnected by agreement due to any cause, the same should be rectified and protection restored to normal condition as quickly as possible. If agreement has not been reached, the electrical equipments shall be isolated forthwith.

(c) The settings of protective relays for 33 KV and 11 KV lines shall be such that a fault in any section does not affect the section between the generating unit and the faulty section under all conditions. The Transmission Licensee shall notify the initial settings and any subsequent changes to the Users from time to time. Routine checks on the performance of the protective relays shall be conducted and any malfunction shall be noted and corrected as soon as possible. Short circuit studies required for deciding the relay settings shall be conducted by the Licensee with the data collected from the Transmission Licensee and the Users. Representatives of the Generating Companies, Transmission Licensees and Distribution & Retail Supply Licensees shall meet periodically to discuss such malfunctions, changes in
the system configuration, if any, and possible revised settings of relays.

(d) The Transmission Licensee shall be responsible for arranging periodical meetings between the Generating Companies and the Distribution & Retail Supply Licensees to discuss coordination of protection. The Transmission Licensee shall investigate any malfunction of protection or other unsatisfactory protection issues. The concerned Licensees shall take prompt action to correct any protection malfunction or other unsatisfactory protection issue as discussed and agreed to in these periodical meetings.

(e) All generating units and all associated electrical equipment of the generating company connected to the Distribution System shall be protected by adequate protection, as per C.B.I.P. manual vide publication 274, so that the system does not suffer due to any disturbances originating at the generating unit.

(f) 33 KV lines: These lines shall have two over current and one earth fault non-directional IDMT protection. It shall also have instantaneous over current element.

(g) Distribution System: For Power Transformers of HV class in the Distribution System, differential protection shall be provided for 10 MVA and above along with backup time lag over current and earth fault protection with directional feature for parallel operation. Transformers of 1.6 MVA and above but less than 5 MVA shall be protected by time lag over current, earth fault and instantaneous restricted earth fault relays. In addition, all power transformers shall be provided with gas operated relays, winding and oil temperature alarm and protection.

(h) Distribution lines: All the 33 KV and 11 KV lines at connection points shall be provided with a minimum of over current and earth fault relays as follows:

   i) Plain radial feeders: Non-directional time lag over current and earth fault relays with suitable settings to obtain discrimination between adjacent relay settings.

   ii) Parallel/ring feeders: Directional time lag over current and earth fault relay.

   iii) Long feeders/transformer feeders: These feeders shall incorporate a high set instantaneous element.
4.8 **Communication**

4.8.1 Reliable communication links shall be established for exchange of data, information and operating instructions between the Licensee, Users with a Demand of 5 MW and above and the SLDC.

4.9 **Voltage, Frequency and Power Factor Monitoring and Control**

4.9.1 The Distribution & Retail Supply Licensee shall monitor the Voltage, Frequency and Power Factors in the Distribution System at different points at peak and off-peak hours and take reasonable measures for improvement of the same in co-ordination with the Users with Demand of 1 MW and above, and the Transmission Licensee.

4.9.2 The Distribution & Retail Supply Licensee shall take Power Factor improvement measures at strategic points in the Distribution System by carrying out System Studies and installing the required Reactive Compensation Equipments.

4.9.3 The Voltage in the Distribution System may vary depending upon the available generation, system demand, and the configuration of Transmission and Distribution Systems at any time. Under normal operating conditions the Licensee shall exercise proper voltage management in the Distribution System beyond the point of interconnection with the Transmission System to maintain Voltage at all levels according to the quality of supply mentioned in the "Distribution System Planning and Security Standard" issued separately. The capacitors, wherever available in the 33 kV substations shall be operated to maintain reactive compensation to be within acceptable limits of power factor of at least 0.9 keeping the bus voltage in view.
4.9.4 Users having Loads with high harmonic content, low Power Factor and fluctuations shall install appropriate correction Equipment.

4.9.5 The Distribution & Retail Supply Licensee shall abide by the instructions issued by the SLDC from time to time on Load management for maintaining the frequency of supply within the specified limits.
4.10 Safety co-ordination

4.10.1 The Distribution & Retail Supply Licensee and the Users and any other Distribution & Retail Supply Licensee having common electrical interface with the Licensee shall designate suitable persons to be responsible for safety co-ordination. These persons shall be referred to as Control Persons. Their designations and telephone numbers shall be exchanged between all the concerned persons. Any change in the list shall be notified promptly to all the concerned.

4.10.2 The Distribution & Retail Supply 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 "Safety Standard for Distribution System" issued separately. 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.

4.10.3 There shall be co-ordination between persons of the Distribution & Retail Supply Licensee and the Users, between persons of two Distribution & Retail Supply Licensees having electrical interfaces, for carrying out the work on any Apparatus or Lines etc., belonging to either party at the point of interconnection.

4.10.4 The provisions of the Grid Code shall be followed at interconnection points in co-ordination with the Transmission Licensee.

4.10.5 The disconnecting device(s) at each electrical interface, which shall be capable of effectively disconnecting the system of the Distribution & Retail Supply Licensee and the other Users, and the grounding devices of the respective systems at the control boundary shall be
identified and marked by the Licensee and the respective Users. These shall be maintained in good condition at all times. To prevent inadvertent switching operations by unauthorized persons, such disconnecting devices shall be provided with interlocks.

4.10.6 Wherever any Consumer has installed an emergency power supply system, either an electronic system with storage batteries or with generators, the arrangement shall be such that the same cannot be operated without clearly isolating the system from the supply mains. The possibility of a feed back from these devices to the Distribution System from any of the conductors, including the neutral conductor shall be clearly ruled out.

4.10.7 The appropriate control person 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 for LCP shall be standardized by the Licensee and shall be used by all concerned.

4.10.8 The Distribution & Retail Supply Licensee in consultation with the concerned User shall frame checklist of operations to be carried out and the procedures for safety coordination for each electrical interface, before issue and return of LCPs. Such procedures and checklists shall be issued to all the concerned by the Licensee for implementation.

4.11 Major Incident or Accident Reporting

4.11.1 The Distribution and Retail Supply Licensee shall send a preliminary report to KERC all the significant Incidents in the Licensee’s Area of Supply which results in interruption to service, substantial damage to equipment or loss of life or significant injury to human beings within
one week of its occurrence followed by a detailed report within one month.

4.11.2 The Distribution & Retail Supply Licensee and the Users shall establish a format and procedure for exchange of information.

4.11.3 The Users shall furnish information to the Distribution & Retail Supply Licensee regarding any major incident occurring in their Systems promptly.

4.12 Reporting Procedure

4.12.1 All reportable incidents occurring in the lines and equipments of 11 kV and above at the 33 kV substations shall be promptly reported orally by the Licensee whose equipment has experienced the incident, to all other significantly affected Users identified by the Distribution & Retail Supply Licensee and the Transmission Licensee. The reporting Distribution & Retail Supply Licensee should submit a written report to the Transmission Licensee within one hour of such oral report. If the reporting incident is of major nature, the written report shall be submitted within two hours duly followed by a comprehensive report within 48 hours of the submission of the initial written report. In other cases, the reporting Distribution & Retail Supply Licensee shall submit a report within five working days to the Transmission Licensee.

4.12.2 The Transmission Licensee shall call for a report from any Distribution & Retail Supply Licensee on any reportable incident affecting other Users and in case such User whose equipment might have been a source of the reportable incident does not report the same. However this shall not relieve any User from the obligation to report Events in accordance with IE Rules. The format for such a report shall be as per the approval of the Distribution Code Review Panel and shall typically contain the following:
xiv. Location of the incident,

xv. Date and time of the incident,

xvi. Plant or Equipment involved,

xvii. Supplies interrupted and the duration wherever applicable,

xviii. Amount of Generation lost, wherever applicable,

xix. System Parameters before and after the incident,
   (Voltage, Frequency, Load, Generation, etc.)

xx. Network configuration before the incident,

xxi. Relay indications and performance of protection,

xxii. Brief description of the incident,

xxiii. Estimated time of return to service,

xxiv. Any other relevant information,

xxv. Recommendations for future improvement,

xxvi. Name and designation of the reporting person.

4.12.3 The report shall contain sufficient detail to describe the Event to enable the recipient to assess the implications and risks arising out of the same. The recipient may ask for clarifications wherever necessary and it is obligatory that the reporting User shall put his best efforts and provide all the necessary and reasonable information.

4.12.4 In case of a request by either party, the oral report shall be written down by the sender and dictated by way of a telephone message or sent by Fax/e-mail to the recipient. In case of an emergency the report can be given only orally and followed by written confirmation.

4.12.5 Reporting of accidents shall be in accordance with the IE Rules, 1956, Rule 44-A. If an accident occurs in the Distribution System resulting in or likely to have resulted in loss or injury to human or animal life, the Distribution & Retail Supply Licensee shall send a telegraphic report to the Electrical Inspector within 24 hours of the knowledge of such occurrence. This shall be followed by a written report in the form
setout in the Annexure XIII of I.E. Rules within 48 hours of the knowledge of occurrence of fatal and all other accidents.

4.13 **Maintenance and Testing**

4.13.1 The Distribution & Retail Supply Licensee shall prepare maintenance schedules for lines and equipment to meet the level of maintenance as required in the "Distribution Construction Operation and Maintenance Standard" and "Safety Standard for Distribution System" issued separately along with the Performance Standard of the Licensee.

4.13.2 Regular testing of all the equipments, such as Transformers, Switchgear, Protective Relays etc., should 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. Wherever the test results indicate a decline in the insulation resistance and/or deterioration of the Equipment, preventive maintenance shall be carried out to ensure serviceability, safety and efficiency.

4.13.3 The Distribution & Retail Supply Licensee shall maintain well trained hot-line personnel, and all the required tools in good condition, and conduct the maintenance work by using hot-line technique, wherever possible, to reduce the period of interruption.

4.13.4 The Users shall maintain their Apparatus and Power Lines at all times conforming to I.E. Rules 1956 and shall be suitable for being connected to the Distribution System in a safe and reliable manner.

4.14 **Tools and Spares**

4.14.1 The Distribution & Retail Supply Licensee shall ensure availability of proper tools and tackles at all work places for carrying out the
maintenance. The tools and tackles shall be checked from time to time and their serviceability shall be ensured.

4.14.2 The Distribution & Retail Supply 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 & Retail Supply Licensee shall make appropriate arrangements for imparting training in both cold line and hot-line work to his workmen and supervisory staff, incorporating up-to-date techniques of Distribution System design, construction and maintenance. He shall frame a suitable syllabus for this purpose.

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KARNATAKA ELECTRICITY REGULATORY COMMISSION

DPCOM – 1
DISTRIBUTION SYSTEM PLANNING AND SECURITY STANDARD

DPCOM – 2
DISTRIBUTION SYSTEM CONSTRUCTION, OPERATION AND MAINTENANCE STANDARD

DPCOM – 3
SAFETY STANDARDS FOR DISTRIBUTION SYSTEM
DOS & DON’TS
DPCOM - 1

Distribution System Planning and Security Standard

1.0 Scope

1.1 This Standard specifies the guidelines for planning methodology of the Distribution System. The system is to be planned by the Distribution & Retail Supply Licensee in accordance with this standard read together with the Distribution Code for providing the required quality and reliability of power supply to the consumers and also to meet the required safety requirements.

1.2 The Distribution & Retail Supply Licensee shall plan and develop the Distribution System in accordance with this standard. The scope of this standard covers the Distribution System comprising of Power Lines and Substations from 33 KV down to 400/230 Volts. The Power Lines and Substations of voltages higher than 33 KV are covered in the Transmission System Planning and Security Standard.

2.0 Quality of power supply

2.0 Frequency: - The rated frequency shall be 50 Hz. All the constituents of the Power System shall make all possible efforts to ensure that the grid frequency remains within the bandwidth of 49.0 -50.5 Hz.

2.1 Voltage: - The highest and the lowest voltages given in the following table shall be considered for design purposes:

<table>
<thead>
<tr>
<th>AC Voltage Band as per IS 12360²</th>
<th>Preferred, Nominal AC System Voltage</th>
<th>Highest System Voltage</th>
<th>Lowest System Voltage</th>
</tr>
</thead>
</table>

² As per the latest version of IS 12360 the preferred nominal phase to phase voltage in Voltage Band II is 415 Volts. The present practice in Karnataka State is 400 Volts phase to phase and the same is retained in the Electricity Supply and Distribution Code, 2000 - 01. The same shall continue for some time till the change takes place to 415 Volts and falls in line with the rest of the country.
The voltage at any point of the system under normal operating conditions shall not depart from the declared voltage by more than the values given below:

Band II  ± 6%
Band III A  + 6% - 9%

2.3 Harmonic content: - As per IEEE recommendations, the total harmonic content in the supply voltage for sensitive loads shall not exceed 5 percent, with any single harmonic content not exceeding 3 percent.

3.0 Load Forecast:

3.1 The Distribution & Retail Supply Licensee shall prepare a rolling long-term load forecast annually for a period of at least five years in his area of supply duly estimating the probable load growth and the consumption pattern of the consumers. The forecast thus made shall be updated every year depending on the actual load that has come in that year and the changes in assumption, if any, required for the next years.

3.2 Preliminary Load Survey:

3.2.1 Domestic and Commercial Loads: -

The consumption in Domestic and Commercial sectors shall be estimated on the basis of the number of consumers and their specific

* Figures in brackets are as per IS 12360.
consumption. The past growth rate in the number of consumers in the area shall be studied. In cases where power shortages have been experienced in the recent past, the growth rate to be adopted shall take into consideration the pent-up demand making due allowance in the growth rate to account for increased tempo of household electrification envisaged in the future. The higher level of electrification planned in the area should be kept in view. Energy consumption per consumer shall be estimated after studying the past trends and taking into account the anticipated improvements in the standard of living.

3.2.2 Public Lighting and Water Works
The estimates of electricity consumption in public lighting and water works shall be based on the average consumption per kilowatt of connected load, projected on the basis of trends, keeping in mind the likely increase in public lighting and water supply facilities. The number of hours of operation shall be estimated taking into account the past trends and the power cuts if any effected in the area.

3.2.3 Agricultural Loads
The power requirement for Irrigation Pump sets shall be based on the program of energisation of pump sets in the plan period, available resources and the ultimate ground water potential. The average capacity of pump sets shall be worked out considering the mid-year figures for connected load and the number of pump sets. The consumption per IP set per year shall be estimated by means of representative sample studies till all the IP sets are metered.

3.2.4 Industrial Loads
The power requirements for industrial sector shall be estimated under three categories, viz.

i. L.T. Industries;
ii. H.T. Industries with a demand of less than 1 MW;
iii. H.T. Industries with a demand of 1 MW & above.

The consumption in category (i) & (ii) shall be on the basis of historical data duly considering the developments in future. In case of category (iii), projection shall be made separately for each industrial unit on the basis of the information furnished by the industrialists and the Department of Industries.

3.2.5 Non-industrial Bulk Supply

The available data regarding the consumption of bulk supply to non-industrial consumers such as research establishments, port trusts, Military Engineering Services, supply to power projects etc., and the probable future developments in these areas, shall be considered for the forecast.

3.2.6 Other Loads

For other loads, the projections shall be based on the best judgement.

3.3 Load Forecast procedure

3.3.1 Load forecasting methods using the above data and relevant indices by adopting one or more of the following methods applicable to specific locations and prevailing conditions shall be adopted.

- Regression model;
- Econometric model;
- Strategic forecasting.

3.3.2 In addition to the above, the effects of Demand Side Management, requirement of power for pending applications, the increase in demand due to improvement in the operating frequency close to 50 Hz shall also be estimated. The Distribution & Retail Supply Licensee shall work out the annual Energy Demand and Peak Demand for each of the succeeding five years relating to each point of interconnection with the Transmission System on the basis of Load forecast.
3.3.3 The diversity factor of each category of consumers fed from each point of interconnection in the area of supply shall be worked out by installation of load survey meters at selected typical locations. A record of such data shall be maintained and continuously updated. The long-term load forecast for a period of five years, based on these data shall be prepared.

3.3.4 The data book listing all system data relating to the Distribution System shall be published. The data book shall be updated every year and copies of the same shall be available to any person upon request, on payment of fair copying charges.

4.0 Planning Procedure

4.1 The Distribution System shall be planned and developed in such a way that the system should be capable of catering the requirement of all categories of consumers with a safe, reliable, economical and quality supply of electricity as indicated in clause 2.0. The Distribution System shall conform to the statutory requirements of Indian Electricity Act 1910, Indian Electricity Supply Act 1948, Indian Electricity Rules 1956 and Karnataka Electricity Reforms Act 1999 as amended from time to time.

5.0 Service Area of a distribution network

5.1 The service area of a distribution network is an area in which the load is supplied by a substation by one or more number of feeders, as required. The distribution network fed from the Distribution Transformers and the Substations from which the 11 KV feeders emanate shall be initially planned as independent networks within their respective service area. Further, wherever possible, provision shall be made for interconnection with adjacent networks and/or substations for an alternate supply in case of failure. The design of distribution lines shall
incorporate features to enable their augmentation in future, with minimum interruption to power supply. The existing right of way shall be fully exploited.

5.2 The Distribution & Retail Supply Licensee shall take suitable measures, sufficiently in advance, to augment the capacity of the feeders in the event the voltage regulation limit specified in CL 2.3 is exceeded within the area.

5.3 Appropriate software to compute the design of the distribution network shall be used to obtain lowest possible energy losses for different loading conditions for the following:

(a) The location and the capacity of the distribution transformers;

(b) Routing of LV and HV networks;

(c) The sizes of conductors;

(d) The ratio of the lengths of HT and LT distribution lines for the new lines planned shall be around 1:1 and the existing Distribution System shall be modified in a phased manner to achieve this ratio.

(e) The voltage regulation limits for all loading conditions.

6.0 Planning Standards

6.1 Standardization of Sizes and Ratings

Adequate provision for future load development shall be made while selecting the sizes of power conductors and rating of Distribution Transformers. The sizes of Power Conductors, Insulators, Lightning Arresters, Transformers, Switchgear, etc. used in the Distribution System shall be standardized with the objective of reducing inventory and standard specifications shall be prepared.
6.2 **Design Criteria for Distribution Lines**

6.2.1 Radial system of distribution can be adopted in rural areas and loop system with provision for feeding from atleast one alternate source shall be adopted in urban areas.

6.2.2 The 11 KV and 400 V distribution lines shall be one of the following types according to the necessity at the required area.

1. Over-head line with bare conductors;
2. Over-head line with Aerial Bunched Cables;
3. Under-ground Cables.

6.2.3 In thickly populated cities, in areas having heavy traffic densities, Under Ground Cable installation shall be considered. Wherever a number of trees are encountered, either in residential locations or in gardens and forests, Over-head lines with Aerial Bunched Cables shall be adopted. In other places Over-head lines with bare conductors shall be adopted. The following standards shall be adopted for planning and design purposes:

(a) The design and construction of over-head lines with bare conductors shall be generally in accordance with IS 5613 Part I, sections 1 and 2.

(b) Vertical configuration of conductors for LT distribution lines, to prevent accidental short circuit due to galloping of conductors, shall preferably be adopted in rural areas since the spans are large in such areas.

(c) The maximum length of LT lines shall not exceed 0.5 KM and that of 11 KV lines shall not exceed 20 KM and the total length of a HT line with spur lines shall not exceed 50 KM subject to voltage regulation limits. Irrespective of the size of the conductor used,
the normal span between the supports shall be suitable for the highest size of conductor adopted in the Distribution System for the particular voltage. (At present "ACSR Rabbit" is the highest size of power conductor used on LT and HT Lines in rural areas. The highest size of power conductors used in urban areas is "ACSR Coyote" for HT Lines and "ACSR Rabbit" for LT Lines. Till such time any other higher size of conductor is introduced from techno-economic considerations, the maximum spans applicable for these conductors shall be adopted irrespective of the size of conductor used.)

(d) The maximum length of 33 KV lines shall be limited to 30 KM subject to voltage regulation limits. The minimum conductor size shall be "ACSR Coyote"

(e) The design and construction of over-head lines with Aerial Bunched Cables shall be generally in accordance with REC Specifications 32 and IS 14255.

(f) The design and construction of under-ground cables shall be generally in accordance with IS 1255.

6.2.4 The line supports can be of steel, wood, RCC or PCC. The RCC and PCC poles are preferred over the other two considering their cost and longer life. The minimum breaking strength of conductors shall not be less than 350 KG. The choice of the size of conductor for a line shall be made based on the following criteria:

a) Power to be transmitted and the techno-economic studies conducted for selecting the size of the ACSR or AAAC conductor according to the cost of loss of power and the interest and depreciation charges on the cost of the conductor thus selected;
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 atmosphere and theft prone areas, All Aluminum Alloy Conductors (AAAC) only shall be used.

g) The present use of ACSR conductor shall be gradually changed to AAAC conductor.

7.0 Reliability Analysis

7.1 The planning of the extension and improvement to a Distribution System shall also take into consideration the improvement in reliability of power supply to consumers. The Reliability indices of power supply in the area fed by the Distribution System before and after the implementation of the extension and improvement program shall be estimated. At present the information for the analysis of the reliability limits under which the distribution system is being operated is not available due to inadequate data. The planning of the distribution system shall also take into consideration the improvement in reliability and efforts should be made to collect the data in this regard.

7.2 The following reliability indices shall be computed:

1. **Customer Average Interruption duration Index (CAIDI):** 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 station or a specified area as follows:

(a) For the Transmission Licensee’s Transmission Line failure:

Sum of product of number of consumers affected from each feeder emanating from the stations in the service area affected by the failure of the Transmission Line and the duration of interruption to each of them

CAIDI= \[ \frac{\text{Sum of product of number of consumers affected from each feeder emanating from the stations in the service area affected by the failure of the Transmission Line and the duration of interruption to each of them}}{\text{Total number of consumers in the service area}} \]

(b) For the Distribution Licensee's feeder failure:

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

CAIDI= \[ \frac{\text{Sum of product of number of consumers affected from each feeder emanating from the stations affected in the service area by the failure of power supply and the duration of interruption to each of them}}{\text{Total number of consumers in the service area}} \]

II. 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.

7.3 The following Factors, which affect reliability indices, shall be considered subject to availability of data:

- Momentary incoming supply failures
- Momentary interruptions on 33 and 11 KV feeders
- Breakdown on LT feeders
• Prearranged shutdowns on lines and feeders
• Blowing out of Distribution Transformer fuses
• Individual fuse off calls

8.0 Standardization of design of Distribution Transformers
8.1 The design of distribution transformers shall be standardized. As an initial step, the various technical parameters required for the design shall be incorporated in the specifications based on the experience on performance gained 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 any manufacturer.

8.2 A good quality assurance plan 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) Strip 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 used etc., tested.

9.0 Standardization of sub-station layouts
9.1 The Distribution & Retail Supply Licensee shall develop standard layouts to fulfil the minimum requirements detailed below:
(i) The layout shall generally be developed as per the requirements of site and system conditions and the orientation of transmission and distribution lines with scope for extension wherever necessary. The bus bars and the minimum clearances adopted shall be as per the following standards and manuals and the provisions of Indian Electricity Rules, 1956.

1. BS 162 – Electrical power switchgear and associated apparatus.
2. BS 159 – Bus bar and bus bar connections.
3. I.S. 3716 – Application guide for insulation co-ordination.

The latest technology in the field and the feedback from the experience gained shall be adopted.

(ii) 33/11KV Substation (10 MVA and above but less than 20 MVA)
The layout adopted shall include the following:

1. Independent circuit breaker control of 33 KV feeders and transformers.
2. Independent circuit breaker control of each 11 KV feeder.

(iii) 33/11 KV Substation (Less than 10 MVA)
The layout adopted shall include the following:

1. Group circuit breaker for transformers.
2. Independent circuit breaker control of 11 KV feeders.

(iv) 11 KV/ 400 V – 3 Phase Distribution Transformer centers.
a. 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 relevant REC Construction Standards and the provisions of Indian Electricity Rules, 1956.

c. The distribution transformers shall be located close to the electrical load center of the loads fed by it as far as possible.

d. The distribution transformers above 250 KVA 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 up to and including 100 KVA. HRC fuses are to be provided wherever the short circuit level is 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 centers in the event the specified voltage regulation limits are exceeded.
9.2 All the 33 KV and 11 KV feeders shall be provided with load survey meters having a memory capacity of 45 days, with 15/30 minutes interval logging.

10.0 Reactive compensation
10.1 Shunt capacitors unswitched/switched type, shall be installed at the appropriate places in the Distribution System for Power Factor improvement, maintaining satisfactory voltage profile and reduction of sub-transmission and Distribution Losses. The size and location of the capacitor installations shall be determined using an appropriate program, with reliable field data. Suitable precautionary measures, such as automatic switching etc., shall be adopted to avoid over voltages at light load periods.

10.2 Optimization studies of shunt compensation shall be conducted by the Distribution & Retail Supply Licensee to determine the most appropriate sizes and locations for shunt capacitor installations. The formulae to be used in such studies, whenever done manually, are included in Annexe-B.

11.0 Service mains
11.1 The service mains to consumers shall be laid in accordance with relevant REC Construction Standards for 230 V single phase and 400 V three phase supply and shall conform to the provisions of Indian Electricity Rules, 1956 in all cases.

12.0 Metering Cubicles
12.1 The metering for 230 V 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 terminals of the meter shall be made tamper-proof and sealed. For 400 Volts three phase supply, the meters and associated metering equipment including connections shall be enclosed in a suitable tamper-proof box. The tamper-proof box shall be of sufficient strength and design with locking and sealing devices 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.

12.2 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 / sealed to prevent tampering.

12.3 The HT metering cubicle shall be suitable for cable entry on both sides or at least on one side. No fuses are permitted in the secondary circuits of the instrument transformers. The metering cubicle shall be painted with suitable epoxy paint for installation in coastal areas and other areas experiencing heavy rainfall. 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 and machinery.

12.4 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 upto the metering panel. There shall be no screwed joints in the pipes and the joints, if any, shall
be welded. The meters shall be as close to the instrument transformers as possible and in no case shall exceed ten (10) metres. The metering panel shall be housed in a weatherproof and tamperproof box and sealed.

13.0 **Security Standards**

The Retail Supply 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 & Retail Supply Licensee.

13.1 The feeders, either HT or LT, feeding important loads such as Hospitals, 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.

13.2 The feeders connected to important industries like Information Technology, primarily based on computer applications which are very sensitive to interruption of even short duration shall be planned to have automatic switchover to an alternate healthy feeder in case of failure of supply.

13.3 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.
13.4 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.

13.5 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 in the adjacent feeder during emergencies.

13.6 In case of single contingency failure of any substation equipment controlling any outgoing 11KV feeder, the load interrupted shall not generally exceed 50% of the total demand on the substation. The Distribution & Retail Supply Licensee has to bring it down to 20% within a period of three years.

13.7 There shall be at least two number of transformers of similar rating in every substation with secondary voltage of 11KV.

13.8 In every substation of capacity 10 MVA and above there shall be a provision for obtaining alternate 33 KV supply to the substation in case of a failure in the incoming supply.

13.9 The design of the Distribution System shall accommodate the arrangements in such a way that the electricity supply need not be interrupted for more than 24 hours in case of breakdown of any distribution transformer. Similarly in case of failure of 11 KV feeders including terminal equipment, the design shall accommodate an arrangement for the power supply not to be interrupted for more than 24 hours.
ANNEXE-A

Calculation of Power loss and Voltage drop.
The power loss and voltage drop of a short line may be calculated by the following formulae:

**Power Loss:**
\[ W = I^2 R \]
Where \( W \) = Power loss per km per conductor in watts,
\( I \) = Line current in amperes, and
\( R \) = ac resistance per km per conductor of the line in ohms.

**Voltage Drop:**
*For single phase lines,*
\[ U = 2 \left( IR \cos \phi + IX \sin \phi \right), \text{ and} \]
*For three-phase lines,*
\[ U = \sqrt{3} \left( IR \cos \phi + IX \sin \phi \right) \]
Where \( U \) = voltage drop per km in volts,
\( I \) = line current in amperes,
\( R \) = ac resistance per km per conductor of the line in ohms,
\( \phi \) = Angle of lead/lag in degrees, and
\( X \) = reactance per km per conductor of the line in ohms.
**ANNEXE B**

**Rating of Capacitor required:**
KVAR = KVA1 \[\sin \varphi _1 - (\cos \varphi _1 / \cos \varphi _2) \sin \varphi _2\]
Where KVAR = amount of capacitance to be added to improve the power factor from Cos \(\varphi_1\) to Cos \(\varphi_2\).
KVA1 = Original KVA

**Optimum location of capacitors:**
\[L = [1 - (KVARC /2 KVARL)(2n-1)]\]
Where L = distance in per unit along the line from substation
KVARC = Size of capacitor bank
KVARL = KVAR loading of the line.

n = relative position of the capacitor bank along the feeder from substation if the total capacitance is to be divided into more than one bank along the line. If all capacitance is put in one bank then the value of n = 1.

**Voltage rise due to capacitor installation**
\[\% \text{ Rise} = \frac{\text{KVARC}. X}{10 V^2}\]
Where \(X\) = Reactance per phase

\(V\) = Phase to phase voltage in KV

***
DPCOM - 2

Distribution System Construction, Operation and Maintenance Standard

1.0 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.

2.0 Construction practice

2.01 The construction of the distribution lines shall be carried out strictly 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 (upto and including 33 KV).

v) IS 14255 - Aerial Bunched Cables for working voltages upto and including 1100 Volts.

vi) REC Specification no 32 - Aerial Bunched Cables for working voltage upto and including 1100 volts.


2.02 As mentioned in item (iii) above, the installation practices of Concrete Poles for 33 KV lines shall be similar to that of 11 KV lines.
2.03 The verticality of poles shall be maintained within reasonable limits of tolerance by concreting of foundation from the bottom up to 150mm above the planting depth in all the types of soil conditions at anchor locations, cut points and transformer centers and all other locations wherever necessary. These shall be suitably designed for the particular soil condition and in any case shall not be less than 450mmx450mm with a mix of ratio 1:2:4 commencing from the foot of the pole and extending up to 150mm above the planting depth. In addition, it may be desirable to concrete every fourth pole in non-cohesive soil.

2.04 After the poles are erected and soil back filled and well compacted and after the first monsoon, the foundation shall be inspected and back filled if necessary.

2.05 For LT lines, the conductors may be of horizontal configuration or vertical configuration. Preference shall be given to vertical configuration. The phase conductors in horizontal configuration should be run on pin or shackle insulators. The neutral conductors may be run on reel insulators. For vertical configuration, the insulators may be fixed on the pole by use of D-type or other suitable clamps.

2.06 Wherever mid-span clashing of conductors is expected due to excessive winds, uneven or excessive sagging, use of fairly longer spans, etc., spacers conforming to REC standard 29 shall be invariably used on LT lines. For tying the power conductors on pin insulators, the top groove tie for tangent locations and the side groove tie for angle locations conforming to REC construction standards C-3 and C-4 shall be used. For dead end locations, strain insulator hardware consisting of helically formed dead-end fitting, Cleves thimble and cross-arm strap with bolts as per REC construction standard C-5 along with disc insulators shall be used.
2.07 The conductors of 11 KV and 33 KV 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.

2.08 To provide for the possibility of conductor breakage in a street or public place a continuous overhead earth wire is to be provided on the poles along the line. Suitable V-guards or earth guard stirrups are to be provided on each pole when the line runs along the street and cradle guards are to be provided when the line runs across the street. Should a line snap or fall down for whatever reason, it should make contact with these earth guards and cause the overload device, whether a fuse or a circuit breaker, to cut off the supply and render the line harmless.

2.09 In case of horizontal configuration, the earth wire may be run on cast iron knob mounted directly on the cross arm. For vertical configuration, the earth wire may be run directly on the D-clamp.

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

<table>
<thead>
<tr>
<th>Capacity of Transformer</th>
<th>Current Rating 11 KV side</th>
<th>Fuse Size SWG</th>
<th>Current Rating LT Side</th>
<th>Fuse Size SWG</th>
<th>Protection Kits up to 100 KVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 KVA</td>
<td>1.31 amps</td>
<td>38</td>
<td>36 amps</td>
<td>38</td>
<td>Protection Kits up to 100 KVA</td>
</tr>
<tr>
<td>63 KVA</td>
<td>3.31 amps</td>
<td>35</td>
<td>91 amps</td>
<td>35</td>
<td>Protection Kits up to 100 KVA</td>
</tr>
<tr>
<td>100 KVA</td>
<td>5.25 amps</td>
<td>33</td>
<td>144 amps</td>
<td>33</td>
<td>Protection Kits up to 100 KVA</td>
</tr>
<tr>
<td>250 KVA</td>
<td>13.13 amps</td>
<td>23</td>
<td>360 amps</td>
<td>23</td>
<td>2 of 15 MCCBs</td>
</tr>
<tr>
<td>300 KVA</td>
<td>15.75 amps</td>
<td>23</td>
<td>433 amps</td>
<td>23</td>
<td>250A-2 nos.</td>
</tr>
<tr>
<td>500 KVA</td>
<td>26.24 amps</td>
<td>20</td>
<td>722 amps</td>
<td>MCCBs 250A-4 Nos.</td>
<td></td>
</tr>
</tbody>
</table>

2.11 Spare fuses, of all the required sizes, shall be made available with all the linemen in-charge of maintenance along with their toolkits and these should be promptly replenished as and when they have been used for replacement to avoid use of improper fuses by them.

2.12 The cross-arms shall be permanently and efficiently earthed. The continuous earth wire shall be securely clamped to each support and connected with earth at four points in every KM. The mechanical connectors of line-traps at the conductor end of the earth connection should be solidly bolted down to the metal parts of the cross arms and supports using suitable washers after the surface has been emeried to remove all rust and paint.

2.13 It is not enough to have a good earth connection initially at the time of erection of the line, but it should also be maintained properly.

2.14 Each stay wire shall be similarly earthed unless an insulator has been inserted in it at the top.

2.15 Earthing shall be in accordance with IS 3043 Code of practice for earthing. The minimum length of ground electrode shall be 2500 mm. The diameter of the ground electrode shall be at least 40 mm for GI pipes or 20 mm for GI rods as per REC Construction Standards J-2. In all 33 KV substations, only cast iron pipes shall be used for earth electrodes.

2.16 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

<table>
<thead>
<tr>
<th>Transformer Rating</th>
<th>Insulated PVC single core stranded aluminum conductor.</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 KVA and below</td>
<td>16 sq.mm.</td>
</tr>
<tr>
<td>75 KVA</td>
<td>25 sq.mm.</td>
</tr>
<tr>
<td>100 KVA</td>
<td>35 sq.mm.</td>
</tr>
<tr>
<td>150 KVA</td>
<td>70 sq.mm.</td>
</tr>
<tr>
<td>200 KVA</td>
<td>95 sq.mm.</td>
</tr>
<tr>
<td>250 KVA</td>
<td>150 sq.mm.</td>
</tr>
<tr>
<td>300 KVA</td>
<td>225 sq.mm.</td>
</tr>
<tr>
<td>500 KVA</td>
<td>300 sq.mm.</td>
</tr>
</tbody>
</table>

2.17 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

<table>
<thead>
<tr>
<th>Rating of 400 V 3 phase 50 Hz equipment in KVA.</th>
<th>Size of PVC insulated Aluminum earthing conductor.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5</td>
<td>6 sq.mm.</td>
</tr>
<tr>
<td>6 to 15</td>
<td>16 sq.mm.</td>
</tr>
<tr>
<td>16 to 50</td>
<td>16 sq.mm.</td>
</tr>
<tr>
<td>51 to 75</td>
<td>25 sq.mm.</td>
</tr>
<tr>
<td>76 to 100</td>
<td>35 sq.mm.</td>
</tr>
<tr>
<td>101 to 125</td>
<td>50 sq.mm.</td>
</tr>
<tr>
<td>126 to 150</td>
<td>70 sq.mm.</td>
</tr>
<tr>
<td>151 to 200</td>
<td>70 sq.mm.</td>
</tr>
<tr>
<td>201 and above</td>
<td>185 sq.mm.</td>
</tr>
</tbody>
</table>

2.18 The voltage gradient at the earth electrode at the transformer center 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\textsuperscript{3}.

\textbf{TABLE 4}

\begin{center}
\begin{tabular}{|c|c|c|c|}
\hline

\end{tabular}
\end{center}

\begin{flushright}
\end{flushright}

\textsuperscript{3} It should be noted that the maximum voltage gradient over a span of 2 meters adjacent to a 25 mm
diameter electrode is reduced from 85\% of the total electrode potential when the top is at ground level to
20 and 5 percent when it is buried at 0.3 and 1.0 meter respectively.
<table>
<thead>
<tr>
<th>Sl.N o.</th>
<th>Particulars</th>
<th>For LT lines (Mtr)</th>
<th>For 11 KV Lines (Mtr)</th>
<th>For 33 KV Lines (Mtr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Minimum height of any conductor of an overhead line across any street.</td>
<td>5.8</td>
<td>6.1</td>
<td>6.4</td>
</tr>
<tr>
<td>b)</td>
<td>Minimum height of any conductor of an overhead line along any street.</td>
<td>5.5</td>
<td>5.8</td>
<td>6.1</td>
</tr>
<tr>
<td>c)</td>
<td>Minimum height of any conductor (bare) of an overhead line erected elsewhere.</td>
<td>4.6</td>
<td>4.6</td>
<td>5.2</td>
</tr>
<tr>
<td>d)</td>
<td>Minimum height of any insulated conductor of an overhead line erected elsewhere.</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>e)</td>
<td>Minimum clearance of overhead conductor from buildings.*</td>
<td>3.5 (2.5)* (vertical)</td>
<td>4.5(3.7)* (vertical)</td>
<td>4.5(3.7)* (vertical)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.8 (1.2)* (horizontal)</td>
<td>1.8(1.2)* (horizontal)</td>
<td>2.5(2.0) * (horizontal)</td>
</tr>
</tbody>
</table>

2.19 Earth electrodes, other than those used for earthing of the fence itself, should not be installed in the proximity of the metal fence, to avoid the possibility of the fence becoming live and thus rendering it dangerous.

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* The clearances indicated in the IE Rules have been increased to have better safety margin in view of the large number of accidents taking place. In case these clearances cannot be maintained, Ariel Bunched Cables shall be used.

* The figures indicated in brackets are as per IE Rules.
2.20 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. It is preferable that these fuse boxes are provided at an inaccessible height.

2.21 The pole mounted distribution transformers shall not be accessible to the public easily. Danger boards shall be invariably provided.

2.22 Suitable Danger boards and anti-climbing devices shall be provided on the poles at locations accessible for human approach such as school premises, market places etc.

2.23 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.

2.24 The minimum clearances from any conductor of an overhead line from ground and buildings at different places shall be maintained is indicted in Table 4. These clearances are the minimum clearances at the lowest point; i.e. at mid span under worst conditions, i.e. when sag is maximum at highest conductor temperature. In actual practice, however, it is preferable to allow a further safety margin of 0.6 meters.

2.25 Bare wires shall not be terminated on a building.

2.26 A tapping can be made only at the point of support. To ensure good contact, only good quality connectors, preferably crimped connectors shall only be used. Twisted joints shall be avoided.
2.27 Fuses along with isolators shall be provided to isolate different parts of the distribution system. Lightning arresters shall be provided on the 11 KV and 33 KV lines at places where the lines terminate for connections to the equipments.

2.28 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 fence with gate wherever possible. "DANGER" Boards shall be prominently displayed on the fence and equipment.

2.29 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 practice 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.

2.30 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 them wires and erect below the power wires, special guarding arrangements of suitable design shall be provided.

Where a telephone or telegraph line passes under a high voltage aerial line on suspension insulators, the protective guarding arrangements shall not be erected using the power line supports. A separate guard shall be located not less than two meters above the telephone or the telegraph line. This shall consist of two horizontal
stranded solid galvanized steel conductors with additional horizontal conductors at the sides where necessary to prevent a broken power conductor from coming into contact with the telephone or telegraph line conductor. This arrangement shall be made in such a way that the broken power conductor is earthed for sufficient duration and ensure the power circuit being tripped out by automatic protective devices. The crossing of telephone or telegraph lines under power lines shall be as nearly as possible at right angles.

3.0 **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

4.0 **Load monitoring**

4.1 Station Log Sheets and Registers for Station operations duly recording the hourly readings of the meters such as current, load, voltage etc., and the station operations shall be maintained at each 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.

5.0 **Load balancing**

5.1 The unbalanced load on the LT side of the distribution transformers shall not exceed 10% of the peak load.
5.2 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.

6.0 **Voltage monitoring and control**

6.1 The Voltage monitoring at each substation feeding 11 KV distribution system shall be carried out by data logging.

6.2 The Voltage monitoring on the LT side of the distribution transformers shall be carried out at least once a week during peak load hours to cover at least two numbers of transformers in each 11 KV feeder as follows:

(a) One Transformer at the beginning of the feeder.
(b) One Transformer at the tail end of the feeder.

6.3 Improvement to voltage conditions shall be achieved by operating OLTC wherever available in 33/11 KV substations and by contacting over telephone the operators of Transmission Licensee at the point of interconnection, to correct Voltage at the sending end whenever required.

7.0 **Data Logging**

7.1 All-important data such as Voltage, Current, Power factor, KW, Transformer data such as tap position, oil/winding temperature, etc shall be logged on hourly basis in all substations feeding distribution lines.

7.2 The following records among others shall be maintained at each station:

a) Operation and maintenance manuals for the equipment and the entire station consisting of the details of operation of the station and maintenance of equipment,
b) Maintenance registers for the equipments and station batteries,
c) Interruption Registers,
d) Line Clearance Register,
e) Equipment registers.

7.3 A detailed analysis of the above data shall be made to assess the performance of the equipments, overloading conditions and the necessity for major maintenance.

8.0 **Load management**

8.1 In the event of total or partial black outs of transmission system or regional system, the Distribution & Retail Supply Licensee shall follow procedures as laid down in the DISTRIBUTION CODE for restoring normalcy.

8.2 In the event of break down within its own system, the Distribution and Retail Supply Licensee shall restore/ maintain supply within the limits specified in the security standards by taking appropriate measures.

9.0 **Communication**

9.1 The Distribution & Retail Supply Licensee shall establish reliable communication facilities such as Fax, E-mail, etc., at major substations. 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.

10.0 **Safety coordination**

10.1 The Distribution & Retail Supply Licensee and the consumers shall abide by the general safety requirements of the Indian Electricity Rules, 1956 for construction, installation, protection, operation and
maintenance of electric supply lines and apparatus, and the procedures laid down in the relevant DISTRIBUTION CODE. The Distribution & Retail Supply Licensee and the consumers shall also follow the Safety Standards for Distribution System issued separately.

10.2 The Distribution & Retail Supply Licensee and the consumers shall abide by the provisions of I.E.Rules, 1956 under Chapter VII “Electric supply lines, Systems and Apparatus for high and extra high voltages.”

10.3 The Distribution & Retail Supply Licensee shall develop safety manuals to meet the safety standards issued.

11.0 Maintenance

11.1 The Distribution & Retail Supply 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 shall be kept 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.

11.2 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.

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

11.4 The maintenance schedules drawn shall cover the following:
   i. Inspection
   ii. Preventive maintenance
   iii. Overhauls

11.5 **Inspection**
This shall include the periodical inspection in service for a check on the condition of the equipments/lines in service to verify the 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.

11.6 **Preventive maintenance**
This shall cover the periodical work including tests required to determine the electrical and mechanical strengths to ascertain the suitability in service and ensure proper working condition. The schedule drawn shall be 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.

11.7 **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 equipments. The schedule drawn shall be 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.

11.8 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.

1. The distribution lines shall be inspected thoroughly before and after the rainy season.

2. The defects noticed during inspection should 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 have to be attended to at the earliest possible occasion duly chalking out a program in advance.

3. 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.

4. Manufacturers' instructions shall always be given due consideration and implemented.

5. A continuous record of all the test results shall be maintained.

6. Appropriate inspection/maintenance checks/history sheets shall be maintained containing details of all inspection and maintenance work done.

7. All the required safety precautions/safety devices shall be used while carrying out the maintenance works.

8. The maintenance schedule shall be periodically reviewed by the Distribution and Retail Supply 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.

11.9 Off-schedule inspections

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

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

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

iii. 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 maintenance action shall be taken whenever and wherever necessary.

iv. 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.

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DPCOM - 3

SAFETY STANDARDS FOR DISTRIBUTION SYSTEM

1.0 Scope

1.1 This standard aims at ensuring safety for the general public from the hazards of electric shock, which may be caused in the Distribution System. The Distribution & Retail Supply Licensee shall
prepare his own Safety Manual based on these standards for his internal use. The Safety Manual shall be prepared in such a way that all the required aspects and safety procedures to be followed are covered in a complete manner without inviting reference to any other codes or standards. The Safety Manual shall also lay down foolproof procedure for issue of necessary permits and clearances to the Engineer in charge of construction and/or maintenance seeking such permits. The designated employees for each substation or sub-transmission/distribution line authorized to issue and receive such permits shall be notified from time to time.

1.2 Reporting of Accidents: Every case where a person receives an electric shock, whether mild or serious or suffers an injury or burn, directly or indirectly due to electrical causes should be treated as an “electrical accident”. The concerned jurisdictional engineer of the Distribution & Retail Supply Licensee shall report the same immediately to the Deputy Electrical Inspector in charge of the area within 24 hours. A copy shall also be sent to the Chief Electrical Inspector to the Government of Karnataka. The designated officer of the Electrical Inspectorate should reach the spot immediately and assess the situation and probable cause of the accident, losses if any to consumers, and the equipment of the Licensee. This should be followed by a detailed report within 48 hours whenever an accident occurs resulting in or likely to have resulted in loss of life of a human being or an animal. The Distribution & Retail Supply Licensee and the Electrical Inspector shall take all other statutorily required actions, such as reporting to the police etc.
1.3 An enquiry should be conducted into every electrical accident. It should be completed with the least possible delay, in any case, not exceeding fifteen days to guard against the possibility of destruction or disappearance of material evidence being presented, to escape responsibility. It should be a searching probe to uncover the root causes of the accident, which sometimes are quite difficult to ascertain. The enquiry should not only fix responsibility for the accident, but it is more important, to spell out steps to be taken to prevent such accidents in future.

2.0 Safety to general public

2.0 Accidents can occur in the Distribution System due to the following causes, which may result in injury to public.

a) Failure of Distribution line supports either due to sub-standard quality or improper erection.

b) Snapping of overhead bare conductors.

c) Improper earthing at Distribution Transformer centers and of the earth wire at certain line supports along the Distribution lines.

d) Inadequate clearances between overhead conductors and ground or buildings.

e) Non-observance of Safety Rules, and abuse of the components of the Distribution System.

2.1 The guidelines indicated in this section, if adhered to, will minimize accidents in the Distribution system and ensure safety to public to the maximum extent possible.

3.0 Actions by Licensee

3.1 The construction and maintenance of the distribution lines shall be strictly carried out as per the “Distribution System Construction, Operation and Maintenance Standard” issued separately. The accidents can be minimized if the construction and maintenance of
the Distribution System is carried out in accordance with the "Distribution System Construction, Operation and Maintenance Standard" issued separately. Wherever the existing System does not meet any of the requirements of this standard, the same should be rectified to meet the requirements of this standard, in a phased manner within a specified time.

3.2 As far as practicable the pole mounted transformers shall not be located near market places, schools and such premises of public congregation.

3.3 Wherever the Distribution Transformers are installed indoors and/or in restricted places susceptible for fire hazards, dry type transformers shall be installed to prevent spreading of fire. For the same reasons, Oil Circuit Breakers shall not be used in such places.

3.4 All the equipment and conductors shall have sufficient rating to carry the estimated maximum load currents continuously and also short circuit currents. They shall have sufficient mechanical strength required for the duty, which they may be required to perform under the environmental conditions of installation, and shall be constructed, installed, protected, worked and maintained in such a manner as to ensure safety to human beings, animals and property.

3.5 The following precautions shall be taken by the Distribution & Retail Supply Licensee, wherever the electrical equipments of the Distribution System are installed in public places, along or across the roads and other places accessible to the public:

(a) The equipments, such as Distribution Transformer centers, Circuit Breakers etc., shall be provided with barricades.

(b) The live parts shall not be easily accessible to the public.
(c) The grounding provided for the equipment and Lines shall be in accordance with IS 3043 - Code of Practice for Earthing. The earth resistance shall not exceed 10 ohms. It is not enough to have a good earth connection at the time of construction, but it should also be maintained in a sound and healthy state at all times. The earth wires and the earth electrodes provided in the Distribution System shall be maintained in good condition to ensure instantaneous operation of the Protective Equipment, either a Fuse or a Circuit Breaker as the case may be, in case of accidental snapping of conductor. In case of failure in the operation of the protective system during any accidental snapping of conductors, the circuit shall be deenergized manually immediately after the same comes to the notice of the concerned employee of the Distribution & Retail Supply Licensee. A detailed investigation shall be done to determine the cause for non-operation of the protective system and remedial measures taken promptly.

(d) The voltage gradient at the earth electrode at the Transformer Center may attain sufficiently high value during heavy flow of ground currents and become dangerous to cattle and human life. To eliminate the possibility of such a danger, the top of 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 soil. Reference is invited to clause no 11.2 of IS 3043 in this regard. Earth electrodes, other than those used for earthing of the fence itself, should not be installed in the proximity of the metal fence,
to avoid the possibility of the fence becoming live and thus rendering it dangerous.⁵

e) The earth leads for earthing the Distribution Transformers and the neutral of LT System shall be of PVC insulated aluminum wires of adequate size. There shall be two separate earth leads.

(f) The earth leads for other pole mounted equipments such as GOS, Fuse units, Lightning Arresters etc., shall be either of galvanized iron brought inside a PVC conduit or PVC insulated wires.

(g) Continuity of earth wire and neutral conductor in LT System should be ensured. For this purpose, the joints if any, in these conductors should be made perfectly using crimped joints. Bolted or twisted joints in wires shall be avoided as far as possible.

(h) Correct capacity fuses shall be provided and maintained in good condition at all Distribution Transformer Centers.

(i) 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 shall be fitted and properly maintained at these connections for the phase wire. There should be a hinged door, which shall be kept closed, and locked from access to the public and shall be periodically inspected and maintained. It is preferable that these inspection boxes are provided at an inaccessible height.

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⁵ It should be noted that the maximum voltage gradient over a span of 2 meters adjacent to a 25 mm diameter ground electrode is reduced from 85% of the total electrode potential when the top is at ground level to 20 and 5 percent when it is buried at 0.3 and 1.0 meter respectively.
(j) The pole mounted Distribution Transformers shall not be accessible to the public easily. Danger boards shall be invariably provided.

(k) Suitable Danger boards and anticlimbing devices should be provided on the poles at locations vulnerable for human approach such as school premises, market places etc.

(l) The maximum span across or along any street shall not exceed 50 meters.

(m) The entire pedestal mounted equipment such as Distribution Transformers, Switchgear, Distribution boxes etc., installed in streets and accessible to the public should be protected by locking the doors and/or providing suitable fence wherever possible. Danger boards shall be prominently displayed on the fence and equipment.

(n) Periodical maintenance shall be carried out on pole mounted Distribution Transformers, Circuit Breakers, 11 KV and LT Distribution Lines, Service Connections and proper records shall be maintained as required in "Distribution System Construction, Operation, and Maintenance Standard".

(o) Special care should be taken to maintain the oil filled equipment properly. Oil leakage, if any, should be attended to immediately. Dry wood or grass or any other inflammable material should not be present in the vicinity.
(p) First aid kits shall be available at every manned sub-station or switching station. Resuscitation charts shall be prominently displayed. All the personnel working in Distribution System shall be trained for the same.

(q) The Distribution & Retail Supply Licensee shall provide sealable cutouts of appropriate rating at the consumer's terminals. No cutouts or fuses shall be provided for the neutral. Only linked switch shall be provided.

(r) Before servicing any electrical installation, either additional or new, the same shall be tested by the Licensee. A record of these test results shall be maintained.

(s) The Distribution & Retail Supply Licensee shall take necessary steps to educate the public and the consumers regarding the safety precautions to be taken by them to prevent shock hazards and consequent danger to them from electricity by issue of pamphlets, exhibiting slides and sign boards at important places, and through media.

4.0 Actions by Consumer

The consumers also should take the following precautions and cooperate with the Distribution & Retail Supply Licensee. The consumers shall take the following measures in their installations in view of their own safety.

(a) Provide Earth Leakage Circuit Breakers of appropriate capacity at their installations.

(b) The load side grounding shall be provided and maintained as per IS 3043 - Code of Practice for Earthing.
(c) Buildings shall not be constructed under EHT Lines. In case the buildings are to be constructed near LT or HT Lines, with bare wires, the following minimum clearances shall be maintained.

<table>
<thead>
<tr>
<th>Particulars</th>
<th>For LT Lines (Mtr)</th>
<th>For 11 KV Lines (Mtr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Minimum height of any conductor of an overhead line across any street</td>
<td>5.8</td>
<td>6.1</td>
</tr>
<tr>
<td>b) Minimum height of any conductor of an overhead line along any street</td>
<td>5.5</td>
<td>5.8</td>
</tr>
<tr>
<td>c) Minimum height of any conductor (bare) of an overhead line erected elsewhere</td>
<td>4.6</td>
<td>4.6</td>
</tr>
<tr>
<td>d) Minimum height of any conductor (insulated) of an overhead line erected elsewhere</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>e) Minimum clearance of an overhead conductor from buildings*</td>
<td>3.5(2.5)* (Vertical) 1.8(1.2)* (Horizontal)</td>
<td>4.5(3.7)* (Vertical) 1.8(1.2)* (Horizontal)</td>
</tr>
</tbody>
</table>

(d) Continuous PVC insulated earth wire of size not less than 3/20 copper wire, shall be run through out the wiring system and connected to the earth terminals of three pin plugs. Two pin Sockets and pins should never be used. This earth wire shall in turn be connected to the load-side grounding electrode. The grounding electrode shall preferably be provided in a place where earth is moist. Alternatively, the earth electrode shall be watered at least once a week. The earth electrode should not be enclosed in concrete.

(e) The consumers should not meddle with the Distribution & Retail Supply Licensee’s equipment such as GOS, Fuses etc.

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* The clearances indicated in the IE Rules have been increased to have better safety margin in view of the large number of accidents taking place. In case these clearances cannot be maintained, Ariel Bunched Cables shall be used
* The figures in brackets are as per IE Rules
(f) Plants which can grow up as trees should not be planted below the power lines. Trimming of branches of trees in the proximity of power lines should not be carried out in the absence of the Licensee's representative.

(g) In case power supply is to be extended temporarily, the connections shall be made properly by a qualified wireman and ELCBs should be provided for extended circuits.

(h) Wires, fixtures and other equipment shall be of good quality with BIS certification mark.

(i) The consumers shall take adequate precautions for the safe custody of the Distribution & Retail Supply Licensee’s equipment in his premises and should not meddle with them.

(j) The wiring diagram and specifications for internal wiring of the multi-storied buildings shall be got approved by the Electrical Inspectorate before executing the work.

(k) The consumer should observe safe practices and Dos and Don’ts as per the enclosed list. The list is indicative and is only intended as guidance.
### ANNEXE

#### 1.0 FOLLOW THE SAFETY PROCEDURE AND AVOID ELECTRICAL ACCIDENTS

<table>
<thead>
<tr>
<th>DO’S</th>
<th>DON’TS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Always use ISI marked and approved quality of wires/ cables.</td>
<td>Do not touch a snapped electric wire</td>
</tr>
<tr>
<td>2. Use Rubber gloves when working on Electrical equipment.</td>
<td>Do not tie animals to electric poles</td>
</tr>
<tr>
<td>3. Use Rubber mats while working on electrical appliances</td>
<td>Do not use GI wire tied to a pole for drying clothes</td>
</tr>
</tbody>
</table>
| 4. Use insulated cutting pliers while handling electric wires & equipments. | Do not over load the system by additional or unauthorized load.  
- Use an appropriate MCB to limit the load. |
| 5. Cover bare portion of Electrical connection with insulated tape. | Do not use unearthed water heaters, geysers, electric iron.  
- Use 3 pin plug and socket for the above equipments. |
| 6. Get the wiring done through a Govt Licensed Electrical Contractor. Insist on production of the licence from the contractor | Do not energize the fence.  
- It attracts violation of Section 39 of the Indian Electricity Act  
If necessary use authorized fencing energizer. |
<p>| 7. Get an electrical installation effectively earthed by good earthing. | Do not climb electricity poles or transmission towers. |
| 8. Frequently water the electrode to maintain the soil resistivity. | Do not use 2-pin plug and socket. |
| 9. Ensure separate earth electrode for the installation and the meter. | Do not use open wires/jointed wires for the appliances. |
| 10. Periodically check the earth lead for its earth continuity. | Do not use broken switches/sockets/plugs. |
| 11. Always ensure that the plug socket is not within reach of the children. | Do not extend loose wiring/open wiring from junction points/plug points. |
| 12. Clean the contact surface of the plug and socket of the electric heater – Replace the socket every 2/3 years. | Do not combine the neutral and body earth leads. Always have a separate and distinct neutral wire and body earth. |
| 13. Always ensure that the matching plug and socket is used to avoid loose contact and consequent heating and melting. | Do not use open heating coil for heating the water. |</p>
<table>
<thead>
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</thead>
<tbody>
<tr>
<td>14</td>
<td>Use 3 only pinplug &amp; socket. 3rd point shall be earthed.</td>
<td>Do not operate the electric equipment/switches with wet hands.</td>
</tr>
<tr>
<td>15</td>
<td>Report slanting poles, inadequate ground clearance to ESCOM</td>
<td>Do not bring the water pipes and electric conduits in the proximity of each other.</td>
</tr>
<tr>
<td>16</td>
<td>Report the leakage of current in the installation to the concerned ESCOM office.</td>
<td>Do not draw the wires/cables for the full cross section of the conduits. – Always limit the concentration to 50% of the conduits.</td>
</tr>
<tr>
<td>17</td>
<td>Install an ELCB/RCCB to avoid fatal shock</td>
<td>Do not lay the underground cables and garden lighting cables/gate lights openly. Always lay them in Hume pipes and clearly demark the cable route.</td>
</tr>
<tr>
<td>18</td>
<td>Always provide graded fuse</td>
<td>Do not allow layman to handle the electric system and appliances.</td>
</tr>
<tr>
<td>19</td>
<td>Always call electrician to repair and checking</td>
<td>Do not build house/extension of house underneath the overhead line/proximity of the line.</td>
</tr>
<tr>
<td>20</td>
<td>Report the accident to ESCOM, Police, Electrical Inspector.</td>
<td>Do not grow trees underneath the overhead lines.</td>
</tr>
<tr>
<td>21</td>
<td>-</td>
<td>Do not have balconies/windows opening towards the open lines.</td>
</tr>
<tr>
<td>22</td>
<td>-</td>
<td>Do not touch a person with bare hands who is in contact with the electric supply.</td>
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<tr>
<td>23</td>
<td>-</td>
<td>Do not carry long and metallic pipe underneath the overhead lines.</td>
</tr>
<tr>
<td>24</td>
<td>-</td>
<td>Do not try to cut tree/branches near the overhead lines without informing KPTCL.</td>
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<tr>
<td>25</td>
<td>-</td>
<td>Do not over load a plug.</td>
</tr>
</tbody>
</table>