Objective of study

- The study highlights how BBMP can implement energy efficiency measures in building in co-ordination with BESCOM.
- Achieve energy efficient and reliable electrical system design for buildings.
- Also the guide line should have compliance with the existing BESCOM regulations.
Necessity of proper Electrical system design are:

- Safety of life and property including equipment.
- Reliability of system input supply and tolerance limit of interruptions.
- Flexibility of plant distribution system.
- Location of the plant sub-station and its deployment.
- Data of electrical equipment, regulation and initial cost including capitalisation.
- Simplicity /flexibility of operation and maintenance.
- Overall cost including running cost.
- Providing quality service.
- Technical parameters and specifications in construction, installation, protection, operation and maintenance.
- Adherence to laid down procedures with accountability.
Guidelines on optimization of electrical load

- load in kW and demand in kVA
- diversity factor
- load characteristics
- future expansion
- Future demand forecasting and planning (building expansion plans).
- Determination of the voltage level required for the building.
- Calculation of short circuit analysis and selection of correct rating for circuit breaker with review of selection of protective devices.
## Classification of Voltage Preferences

<table>
<thead>
<tr>
<th>Industry</th>
<th>Preferred Incoming Voltage Level</th>
<th>Voltage Class as per I.E. Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 MW and above</td>
<td>220 kV</td>
<td>Extra</td>
</tr>
<tr>
<td>Between (10 - 50 MW)</td>
<td>132 - 66 kV</td>
<td>High</td>
</tr>
<tr>
<td>Between (1 to 10 MW)</td>
<td>33 - 11 kV</td>
<td>High</td>
</tr>
<tr>
<td>Up to 50 kW</td>
<td>3 φ, 440 Volts</td>
<td>Medium/Low</td>
</tr>
</tbody>
</table>
Guidelines on Transformer Rating and Selection

- Normally maximum efficiency; of the transformer is designed at the loading in the range of 45 to 50% of its full load capacity.
- The building should be supplied from two independent sources, where continuity of supply is required.
- The capacity of the transformers should be so selected that if one of the transformers fails, the remaining transformer shall ensure supply to the equipments without undue overload.
## ECBC recommended losses for oil cooled transformer

<table>
<thead>
<tr>
<th>Rating kVA</th>
<th>Max. losses at 50% loading kW</th>
<th>Max. losses at 100% loading kW</th>
<th>Total losses at 50% loading kW</th>
<th>Total losses at 100% loading kW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Up to 11 kV</td>
<td>Up to 22 kV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>0.5</td>
<td>1.8</td>
<td>0.6</td>
<td>1.8</td>
</tr>
<tr>
<td>160</td>
<td>0.8</td>
<td>2.2</td>
<td>0.8</td>
<td>2.6</td>
</tr>
<tr>
<td>200</td>
<td>0.9</td>
<td>2.7</td>
<td>0.9</td>
<td>3</td>
</tr>
<tr>
<td>250</td>
<td>1.1</td>
<td>3.3</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>315</td>
<td>1.1</td>
<td>3.6</td>
<td>1.3</td>
<td>4.3</td>
</tr>
<tr>
<td>400</td>
<td>1.5</td>
<td>4.6</td>
<td>1.5</td>
<td>5.1</td>
</tr>
<tr>
<td>500</td>
<td>1.6</td>
<td>5.5</td>
<td>2</td>
<td>6.5</td>
</tr>
<tr>
<td>1000</td>
<td>2</td>
<td>6.6</td>
<td>2.3</td>
<td>7.6</td>
</tr>
<tr>
<td>1250</td>
<td>3</td>
<td>9.8</td>
<td>3.5</td>
<td>11.4</td>
</tr>
<tr>
<td>1600</td>
<td>4.5</td>
<td>15</td>
<td>4.9</td>
<td>16</td>
</tr>
<tr>
<td>2000</td>
<td>5.4</td>
<td>18.4</td>
<td>5.7</td>
<td>18.5</td>
</tr>
<tr>
<td>2500</td>
<td>6.5</td>
<td>22.5</td>
<td>7.1</td>
<td>23</td>
</tr>
</tbody>
</table>
Guidelines on selection of Electrical Motors

- IS 12615 for Energy Efficient motors is the benchmark figures for efficiency.
- High efficiency motors are usually manufactured from materials, which incur lower energy losses compared with standard motors. More care is taken with the design and geometry of the motor construction. The high efficiency motors have been improved in four areas:
  - Longer core lengths of low loss steel laminations to reduce flux densities and iron losses
  - Maximum utilization of the slots and generous conductor sizes in the stator and rotor to reduce copper losses
  - Careful selection of slot numbers and tooth/slot geometry to reduce stray losses
  - Less heat is produced by a more efficient motor so the cooling fan size is reduced. This leads to lower windage losses and therefore less waste power.
Guidelines on improvement of Power factor

- **Methods of improving Power factor**
- Streamlining of the process by improving the electrical performance of the plant.
- Replacing induction motors by synchronous motors of equal rating wherever possible.
- Replacement of under loaded motors with motors of correct rating.
- Reduction of voltage of motors which are regularly under loaded.
- Restricting no load operation of motors.
- Improving motor repair quality.
- Replacement or relocation of under loaded transformers.
- Installation of Capacitors
Measurement of power factor

- by a direct-reading for Power factor meter for an instantaneous value
- a recording VAr meter, which allows a record over a period of time to be obtained. of current, voltage and power factor. Readings taken over an extended period provide a useful means of estimating an average value of power factor for an installation.

Necessity of having good power factor

- Power factor improvement allows the use of smaller transformers, switchgear and cables, etc. as well as reducing power losses and voltage drop in an installation.
Guidelines on distribution system losses

- The distribution losses in the system are mainly on account of the losses in the cables and bus bars. The parameters that affect the cable losses are mainly cable resistance, power factor and voltage levels.

Losses

- In-plant cable losses are in the range of 1% to 4%.
- Cable laying should be done strictly in accordance with carefully and systematically planned schedule.
- Drawing of this should be available at site and should be preserved at sub-stations. All cable ends should be suitably labelled to facilitate easy identification.
- In all control cables adequate number of spare cores should be included. For cables, use IS:1255-1958, IS:962-1965 and IS:3043-1966 standards.
Guidelines on Power back up systems

- **Captive power generation offers the following advantages:**
- Continuous availability of power, free from utility power breakdown and grid disturbances, etc., leading to better productivity, less interruptions in process restart etc.,
- Good power system control obtained when operated in parallel with the utility supply system
- Possibility of heat and electrical energy generation (Cogeneration) resulting in energy conservation and reduced energy cost,
- Excess electrical energy generation can be supplied to the utility grid and earning income/ wheeling charges.
Modes of operation of DG sets

- Standby Power supply Mode (Emergency Power Supply): Captive power generation set utilised in this mode shall meet the plant part load or total load requirement during the failure of utility power supply.
- Peak Loading Mode
- The specific energy generation (SEGR) of the DG sets varies with size and loading on the DG sets. A SEGR of 4 kWh/l is said to be an efficient design.
An uninterruptible power supply, or battery back-up, is an electrical apparatus that provides emergency power to a load when the input power source, typically the utility mains, fails.

A UPS differs from an auxiliary or emergency power system or standby generator in that it will provide instantaneous or near-instantaneous protection from input power interruptions by means of one or more attached batteries and associated electronic circuitry.

The efficiency level of the inverters varies from 92 - 95 % based on the capacity.
# Guidelines on Power Quality

<table>
<thead>
<tr>
<th>Ranges</th>
<th>Line-to-Line rms. Values</th>
<th>Standard Nominal A.C. System Voltages</th>
<th>Tolerance on Declared Voltage</th>
<th>Voltage adopted for the system</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>50 V ≤ u ≤ 1000 V</td>
<td>Three phase - 415 V Single phase - 240 V</td>
<td>± 6 %</td>
<td>Distribution system</td>
</tr>
<tr>
<td>II A</td>
<td>1 kV &lt; u ≤ 52 kV</td>
<td>3.3, 6.6, 11, 33 kV</td>
<td>0.06-0.09</td>
<td>Sub-transmission Transmission</td>
</tr>
<tr>
<td>II B</td>
<td>52 kV &lt; u ≤ 300 kV</td>
<td>66, 132, 220 kV</td>
<td>± 12.5 %</td>
<td>Transmission</td>
</tr>
<tr>
<td>III C</td>
<td>U &gt; 300 kV</td>
<td>400 kV</td>
<td>± 12.5 %</td>
<td>Transmission</td>
</tr>
</tbody>
</table>
The voltage ranges in which the AC installations are classified (as per IS: 12360 - 1988)

- Phase to phase voltage imbalances by even 2.5 % of the nominal voltage can reduce motor efficiency up to 10 %.
- The limit of negative phase sequence as per IEC34-1 is 2% of the voltage.
Mandatory clause to be included in the Revised BESCOM regulation

- The power factor of the building shall not be less than 0.95
- The transformer losses at 50% and 100% load shall be in accordance with the conditions specified in ECBC 2007.
Compliance Requirement - Transformer

- Provide transformer loss at 50% and 100% load
## Compliance Requirement - Transformer

<table>
<thead>
<tr>
<th>S No</th>
<th>Type</th>
<th>Rated kVA</th>
<th>ECBC recommended loss at 50% load</th>
<th>Actual loss at 50% load</th>
<th>ECBC recommended loss at 100% load</th>
<th>Actual loss at 100% load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note – Test certificate from the manufacturer showing above specification needs to be submitted.
Power Factor Correction

● All electricity supplies exceeding 100A, 3 phases shall maintain their power factor between 0.95 lag and unity at the point of connection.

● Presently in Bangalore city, there are penalties for LT connections with PF less than 0.85, a surcharge of 2 paise per unit consumed will be levied for every reduction of PF by 0.01 below 0.85. However, and in respect of LT installations the surcharge is limited to a maximum of 30 paise per unit.

● It is proposed to increase the PF to such installations to 0.95 to reduce the Transmission and Distribution losses. Any LT connection having a PF of less than 0.95 a levy has to be charged as prevailing earlier.

● BESCOM has agreed to implement penalty if the PF maintained is less than 0.95.
Mandatory use of energy efficient transformers

- Under this project use of energy efficient Transformer, for buildings with HT supply has been made as a mandatory regulation.
- BESCOM to take the initiative to check at the time of giving electricity connection that ECBC compliant transformers are installed in new buildings, with HT Power supply
Mandatory Energy audit for commercial buildings above 600kVA

- BESCOM can provide incentives for commercial establishment to carry out energy audit and reduce the energy consumption.
- The incentive mechanism can be structured in a way that the present energy consumption before commissioning the audit represents the baseline figures.
- Any reduction in energy consumption after implementation of the energy saving recommendations within a reasonable time frame should have an incentive to the extant of actual reduction in kWh for the same operating conditions.
Tariff slabs related to Energy Performance Index in place of units.

- It is being proposed to BESCOM to revise the structure and introduce tariff slabs related to Energy Performance Index in place of units.
# Existing tariff structure

<table>
<thead>
<tr>
<th>Tariff Schedule LT-3(i) (Low Tension)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed charges per month</strong></td>
</tr>
<tr>
<td><strong>Energy Charges</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Applicable to – All offices, Police Stations, Commercial Complexes, Information Technology (IT) enabled services, I.T. based medical transcription centers
## Proposed tariff structure

### Tariff Schedule LT-3(i) (Low Tension)

Applicable to – All offices, Police Stations, Commercial Complexes, Information Technology (IT) enabled services, I.T. based medical transcription centers

<table>
<thead>
<tr>
<th>Fixed charges per month</th>
<th>Fixed charges Rs. 35 per KW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Charges</td>
<td>If consumption is below EPI</td>
</tr>
<tr>
<td></td>
<td>505 paise/unit</td>
</tr>
<tr>
<td></td>
<td>If consumption is higher than EPI</td>
</tr>
<tr>
<td></td>
<td>600 paise/unit</td>
</tr>
</tbody>
</table>
Thank You