9 ELECTRICAL SYSTEM

9.1 Introduction

This chapter deals with power system design basis for transmission & distribution network of Wave CIty. The aim of this section is to create design planning basis for detailed design implementation. Existing and prevailing system studies were carried out for conceptualising of design parameter & network. This section discusses the Electrical System in respect of design, planning and distribution of design basis, load forecast, distribution network and Illumination. The details are based upon accepted standards and norms.

9.2 Codes and Standards

The following standards and codes (latest editions/ revisions) shall be used to govern the design of the electrical system:

- BIS: Bureau of Indian Standard
- BS : British Standard
- IEC: International Electro technical commission
- IER: Indian Electricity Rules
- NEC: National Electricity Code
- Regulations lay down by Indian Electricity Rules
- Regulations laid by chief controller of explosives
- Regulations/ guidelines and practices laid under UPPCL / PVVNL / UPPTCL
- Regulations lay down by tariff advisory committee / Fire insurance regulations

9.3 Load Forecast

For arriving at ultimate load forecast of Hi-Tech & Green Tech city following norms have been considered (*Refer Table 9.1)*

For overall load demand forecast of Hi-Tech

Residential	: -	50 watt per sq.meter
Commercial	: -	150 watt per sq.meter
Public/semi public area	: -	25 watt per sq.meter
Industrial	: -	80 watt per sq.meter
Recreational	: -	50 watt per sq.meter

Table 9.1 : Load Forecast Summary

HI-TECH CITY		
S.N	Utility Type	Load (MW)
1	Residential	570
2	Commercial	525
3	Public / Semi Public	37
4	Industrial	80
5	Recreational	2.87
6	Open Spaces & Green	2.56
7	Roads	5.92
TOTAL LOAD (MW)		1223
Overall Diversity @ 0.7		856
TOTAL LOAD (MVA) (@ 90% loading and 0.9 PF)		1057

Demand Factor for various utilities considered:-

Residential	: -	50%
Commercial	: -	75%
Public/Semi Public	: -	50%
Industrial	: -	75%
Recreational	: -	70%

9.4 Existing Power Network

Currently the site has Three (3) EHV transmission lines running across NW-SE alignment. These lines are originating from NTPC Dadri power station. (Refer figure 9.2)

A power grid 400kV substation located outside site boundary will serve as preliminary power source provider at 220kV level.

As understood from figure 9.5: % load forecast (100% commercial), the residential load is 50% as against 70% of total residential load as projected in ESC 2005 – Supply code UPERC Tariff Plan LMV1 (DisCom's Retail Tariff) .

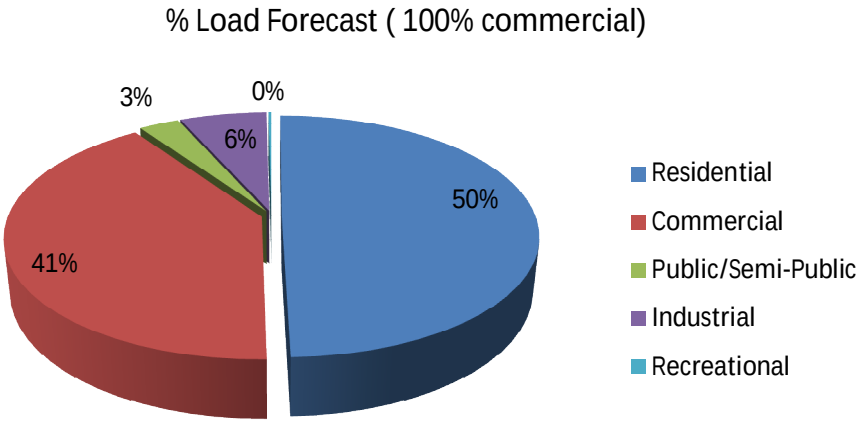

Figure 9.5: % load Forecast (100% commercial)

Hence, two options were proposed to bring down the overall commercial load on substations.

Residential, neighbourhood commercial, industrial parcels having load up to the permissible limit shall receive 33kV feeders from nearby 220kV ESS.

9.5.2 11/.0433kV Substation:-

For common services, utilities, plots having load up to 50kW shall receive supply from 11/.433kV substations. These substations shall be planned and located near to load centres for keeping voltage level within limits and minimizing cable runs. It is proposed to have unitised substation over conventional ones;

1. Compact in nature (HT panel , Transformer, LT panel, APFC are housed in an enclosure)hence requires less space
2. Aesthetically pleasing
3. Ease in operation & maintenance.

The incoming 11kV cable shall be laid underground from nearby 33/11kV substation. These substations shall be connected in Ring main arrangement through Ring main units. The capacity of these substations shall be as per designed load forecast and as per available standard ratings of 63kVA / 100kVA/ 250kVA/ 400kVA/ 630kVA.

9.5.3 Voltage Regulation:-

Installation of power factor compensation equipment at incoming end of individual unit by its owner is mandatory. The following limits of voltage regulation as prescribed in the Indian Electricity Rules (IE-1956) have been considered:

Table 9.2 : Voltage Regulation

SYSTEM RATED VOLTAGE (VOLTS)	MAXIMUM PERMITTED VARIATION %
Upto 650 V	**±6**
650 – 33000	**+6/-9**
Above 33000	**-12.5/+10**

9.5.4 System of Supply:-

a. Uninterrupted power supply shall be maintained at a frequency of 49.02-50.5 Hz, the frequency band for operation of the grid ordered by the Central Electricity Regulatory Commission.
b. The declared voltage of the AC supply shall be as follows:
   i. Low Tension (LT) - Single Phase: 230 volts between phases and neutral.
   - Three Phase: 400 volts between phases.
   ii. High Tension (HT) - Three Phases: 6.6 KV/ 11KV/ 33 KV.
   iii. Extra High Tension (EHT) - Three Phases: 66 KV/ 132 KV/ 220 KV.

c. Load distribution to consumers shall be on the basis of sanctioned load in following manner:

i. Load up to 50 kW: -

The L.T. supply from existing mains shall be provided. However depending on consumer's plot utility the final supply voltage may be decided.

ii. Above 50 KW and up to 450 KW (500 kVA): -

11 KV feeders shall be provided from nearby 33kV or 220kV substation.

iii. Above 450 KW and up to 2550 KW (3000 kVA extending up to 5000kVA): -

11 KV feeders shall be provided from the nearest 33 KV or 220 KV substations.

iv. Above 2550 KW up to 8500 KW (10,000 kVA extending up to 20,000kVA): -

33KV feeder shall be provided from 33 KV or 220 KV substations.

v. Above 12,500 KW (15,000 kVA or 20,000 kVA): -

Depending on overall plot utility and designed load demand 132 KV or 220kV feeders from nearest 220 KV or 400kV sub-station.

9.5.5 Classification of Supply :-

The distribution system shall be planned to give supply at a voltage and phase indicated as below:

a. Low Tension

(a) All installations , with a contracted load less than 5 KW - Single phase at 230 V

(b) All installations with a contracted load of 5KW or more and up to 50 KW / 63 KVA - 3 Phase, 4 wire at 400 V

b. High Tension

(a) Contracted load exceeding 63 KVA and up to 3000 KVA - 3 Phase at 6.6 / 11 KV

(b) Contracted load exceeding 3000 KVA and up to 10000 KVA - 3 Phase at 33 KV

c. Extra High Tension

Contracted load exceeding 10000 KVA - 3 Phase at 132 / 220 KV

9.5.6 Power factor :-

a. It is advisable to maintain the desired average power factor of 0.9; however state specific power factor norms may be adopted.

b. The supply should be temporarily disconnected if power factor is below 0.75 so as to maintain quality of power supply without any penalty.

9.5.7 Load Balancing

a. The system shall be so designed so that load unbalance does not exceed 5 % at the point of commencement of supply.
b. The consumer taking three-phase supply shall also balance his load in such a way that the difference in loading between each phase does not exceed 5% of the average loading between the phases.

9.5.8 Point of Supply

a. The overall distribution of supply to plots shall be planned to be given at a single point, in premises, at the outgoing terminal of the client distributor (licensee). The Licensee shall determine the point of supply such that the meters and other equipment are always accessible to the Licensee without obstruction. However, depending on the consumer's plot utility planning and layout supply may be provided at more than one point.
b. There shall be independent entry to the metering cubicle at all EHT & HT consumer premises.

9.5.9 Installation of equipment at point of supply

a. At the point of instigation of supply, the consumer (plot owner) shall provide a main switch/circuit breaker from the outgoing terminal of the meter.
b. Provision of protective devised for HT/EHT consumers shall be in accordance with Rule 56 and 64 of the Indian Electricity Rules 1956 and thereafter as per regulations framed under Section 53 of the Electricity Act, 2003.
c. HT/EHT consumer/applicant shall install step down transformers with a vector group with delta winding on the high voltage side and star winding on the low voltage side, with the neutral terminal brought out and solidly earthed.