

**“Estimation of Capital Expenditure of the  
Andhra Pradesh Southern Power Distribution Company Limited’s  
Resource Plan Proposal for the fourth control period ”**

**Dissertation Report**

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Further, I certify that the work is based on the investigation made, data collected and analyzed by her and it has not been submitted in any other University or Institution for award of any degree.

In my opinion it is fully adequate, in scope and utility, as a dissertation towards partial fulfillment for the award of degree of MBA.

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# Abbreviations

MYT	Multi Year Tariff
ARR	Aggregate Revenue Requirement
O&M	Operation and Maintenance
RRB	Regulated Rate Base
FPT	Filing for Proposed Tariff
DISCOM	Distribution Company
APSPDCL	Andhra Pradesh Southern Power Distribution Company Ltd
GFA	Gross Fixed Assets
EE	Employee Expenses
R&M	Repair and Maintenance
A&G	Administrative and General
DTR	Distribution Transformers
ERC	Electrical Regulatory Commission
STU	State Transmission Utility
CEA	Central Electricity Authority
NEP	National Electricity Policy
NTP	National Tariff Policy
CERC	Central Electricity Regulatory Commission
APERC	Andhra Pradesh Electricity Regulatory Commission
CDM	Clean Development Mechanism



## **EXECUTIVE SUMMARY**

In order to give an element of certainty to licensees and consumers, the Electricity Act 2003 had made provision to incorporate Multi Year Tariff regime in the Distribution and Retail supply Business of the licensees. The main idea lies under the implementation of MYT is to have prior certainty in the licensees business while they are planning their future expenditure against the needs of consumers, business, technological up-gradation, social and employees. If the licensees could able to plan their expenditure by foreseeing above said needs, it would give a clear insight to the consumers in analyzing the cost incurred by the licensees in providing affordable, reliable and quality supply.

Among the expenses incurred by the licensees, Capital Expenses are comes under major chunk of expenses, which includes network improvement, HVDS, IPDS, Rural Electrification, technological up-gradation like smart metering and infrastructure improvement like construction of offices, substations and training centers etc.

The accurate estimation and projection of capital expenditure in Resource plan will recover the near to exact Distribution cost in ARR. In addition to that, it will also eliminate the burden to the future consumers in bearing the revenue gap arrived because of difference of the actual expenses and approved expenses of the previous control period.

The capitalization of the capital expenditure will be added to the Gross Fixed Assets of the company in distribution MYT will recover the near to exact RRB in ARR. This project will give the information regarding the various cost components in the Capital Expenditure of a power distribution company, information regarding the various important parameters is taken into consideration while analysing the capital expenditure of a Discom. The result of this analysis will give insight to the Power Distribution Company while planning the future business expansion and it will enforce effective strategies to optimize their expenses.

# Chapter 1

## Introduction

### 1.1 Overview of ARR of the distribution business

*“Every Distribution Licensee will file for each of its licensed business an application to get approved of its Aggregate Revenue Requirement (ARR) for every year of the Control Period, not less than 120 days before the commencement of the first year of the Control Period. This filing will be in a specified form and manner in accordance with the guidelines issued by the Commission. Before the commencement of the Control Period, the Distribution Licensees have to file such applications for ARR of the first Control Period within a period not less than 90 days. The ARR filing for the Distribution business will be for the entire Control Period”- APERC Regulation 4, 2005.*

(Aggregate Revenue Requirement) ARR includes:

1. Different types of costs are covered in the Operation and Maintenance (OM): repair maintenance, employee-related, and administrative general costs. These costs are estimated for the base year and also to the year prior to it. They are calculated along with annual predictions during the control period grounding on the regulations

provided by the distribution licensee. These regulations include indexation and other appropriate mechanisms.

2. For every base year and the year of the control period (CP), Capital Investment Plan (CIP) with scheme wise details and the requirement of the working capital shall be submitted. The CIP shall include annual capitalization schedule of the CP agreeing to the Resource Plan approved by the Commission.
3. To calculate the Weighted Average Cost of Capital, a scheme was prepared for the capital structure and the financing cost. These include equity returns and the cost of interest.
4. To minimize the losses during power distribution during the CP following the licensee Performance Regulation standards, proposal of the targets will be made.
5. Depreciation details which contains Advances given against any required depreciations and the annual capitalization schedule during CP.
6. External parameters are detailed for the indexation.
7. Descriptions of the income taxes:
8. Other expenditure related issues:
9. Instructions are provided to distribute the gains and losses;
10. Proposals made to target efficiency parameters;
11. Recommendations for recognizing the performance efficacy
12. Appropriate other related matters.

In relation with Point no. 2 given above, the Distribution licensee needs to give the Resource Plan with the Regulatory Commission including the Sales Forecast, Power Procurement Plan, Load Forecast and Capital Investment Plan for distribution duly fulfilling the requirements of the Commission's Guidelines.

**ARR for Retail Supply Business:** - The Aggregate Revenue Requirement for Retail Supply Business needs to include:

- a Prices for Power purchase for each year of the Control Period. The price will also cover the transfer price of own generation for the supply business in accordance to the Power Procurement Plan as accorded by the Commission as a part of the Distribution Licensee's Resource Plan.
- b All other items referred and applicable for the power distribution business and in line with cost allotment statement referred to clause 5 of the related Regulation.

**Filing for the proposed tariff(FPT)**

The FPT for Distribution business and Retail Supply business will be filed along with the corresponding ARR filings.

The proposal will be prepared for :

- a Tariff calculation of Wheeling electricity Charges to retrieve the ARR of Distribution Business
- b Tariff calculation of Retail sale of electricity to retrieve the ARR of the Retail Supply Business

**Distribution Business:-** The application for Filing for Proposed Tariff includes:

- a The estimation of Distribution network utilization of each year of the Control Period in accordance to the Resource Plan.
- b Proposals for determination of tariffs for transmission of electricity or Wheeling for each year of the Control Period including the transmission and other losses to be charged in kind and the procedure therefor.
- c Proposals for the income not from tariff with element wise detailed description

- d Proposals with respect to the revenue from other areas of business.
- e The wheeling costs will be quoted voltage wise: For the beginning Control Period, the Distribution Licensee needs to quote these costs calculated on regulating basis
- f Expected revenue from the proposed electricity transmission charges, Non Tariff revenue and Income from other areas of businesses

**Retail Sale of Electricity:** The application for Filing for Proposed Tariff includes:

- a Proposal for retail sale of electricity to the consumers corresponds to its retail supply business. The details include unit rates for all kinds of consumers classifying based on their consumption, category of consumption and also voltage-wise. The charges quoted covers energy consumption charges, development charges and minimum utilization charges.
- b Proposals for the income not from tariff with element wise detailed description.
- c The tariff scheme proposed by the Distribution Licensee shall be submitted with a cost-of-service model designating the charges of the licensed business in accordance to every category of consumers based on the proper assumption.
- c Expected Revenue from the proposed Retail Sale Tariffs, income from Other Business(es) and Non-Tariff Income considered appropriate by the Distribution Licensee, including the incentive schemes to consumers, voltage surcharge and power factor surcharge

### **Disposal of applications**

The Commission will pursue the Distribution Licensee's filing according to the Regulation and its Conduct of Business Regulations.

The commission may consider and accept the application considering the recommendations from the people, other stakeholders and the filing of the Distribution Licensee, with

such changes within the time frame of 120 days after receiving the formal application and an order containing inter alia targets for every year of the CP.

### **Resource Plan**

- The Distribution Licensee must provide a Resource Plan (RP) on the 1st of April annually after the first year of CP for approval from the Commission. The RP shall contain the Sales and Load Prediction, Power Procurement Plan and a Distribution Plan in coordination with the guidelines of the Commission in terms of Load Prediction and Resource Plan amended along with the time: Given the RP for the first CP may be applied along with the Multi-year applications for ARR of the first CP.
- The Commission shall approve the RP as per the Guidelines on Load Predictions, Resource Plan (Distribution Plan and Power Procurement Plan) and the Distribution Licensee shall adopt them in the Multi-Year and Annual filings for the Control Period.

### **Multi-year tariff framework and approach**

- The multi-year tariff framework shall be based on the following approach, for calculation of aggregate revenue requirement and expected revenue from tariff and charges.
- Base Year:- Values for the Base Year of the Control Period shall be determined based on the audited accounts available best estimate for the relevant years and other factors shall be considered by the Commission, and after applying the tests in order to determine the controllable or uncontrollable nature of various items. Normally, the Commission will not reexamine the performance targets even if they are fixed on the basis of base values of un-audited accounts.

## 1.2 Investment plan

The Commission shall adopt the Capital Investment Plan approved as part of the Resource Plan in terms of clause 9 of this Regulation for the purpose of determining the Regulated Rate Base(RRB) at the commencement of the Control Period.

Provided that for the first Control Period, the Distribution Licensee shall file its Capital Investment Plan for the Control Period as part of its Multi-Year Filings for Commission's approval.

The Distribution Licensee shall seek approval for individual schemes in the Capital Investment Plan at least 90 days before undertaking the investment in accordance with the Guidelines on Investment Approval. The individual schemes/ projects submitted by the Distribution Licensee for Commission's approval must provide complete details including those relating to the cost and capitalisation for each year of the Control Period.

The Commission may provide corrections in the ARR of the Distribution Licensee for subsequent years of the Control Period to the extent of deviation from the investments approved as part of the Capital Investment Plan. The Distribution Licensee shall justify the deviations beyond 10 percent for each individual scheme/project and any other material deviations from the Capital Investment Plan including introduction of, or substitution of existing schemes / projects by, new scheme/project(s).

## 1.3 Purpose of the study

APERC Regulation 4 of 2005 states that *“every Distribution Licensee will file an application for all of its licensed business to get approved of its Aggregate Revenue Requirement (ARR) for every year of the CP”*. ARR and Tariff fixation for every year of the CP is determined at once in advance for the entire period of 5 years. The projection of controllable costs in the multiple years tariff shows the distribution cost in ARR filing.

The accurate projection of the controllable costs in Multi Year Tariff will reflect the accurate Distribution cost in Aggregate Revenue Requirement (ARR) filing. The accuracy in the projection of the controllable items of the Multi Year Tariff will eliminate the process of True-up petition of Licensee towards the recovery of his actual expenditure for the entire control period. Moreover it also eliminates the regulatory assets' creation and cost of its carrying.

The Capital Expenditure is one of the major expenses in the DISCOM's Aggregate Revenue Requirement (ARR) of Distribution business. The accurate estimation and projection of Capital Expenditure in Distribution MYT will recover the near to exact Capital Expenditure in ARR of Distribution business and the expenditure which in turn adds to the Gross Fixed Asset of the company. In addition to that, it will also increase the Regulated Rate Base of the company and Return on Capital Employed of the investment.

This gives the knowledge with respect to the different cost segments in the capital costs of a Power Distribution organization, knowledge in regards to the different significant parameters

mulled over while investigating the capital costs of a DISCOM. The consequence of this investigation will shed light to the Power Distribution Organization while arranging the future business extension and it will uphold viable techniques to improve their costs.

## 1.4 Research hypothesis

The licensee has projected the sales for ensuing years by using compounding average growth rate (CAGR) duly using the above unrestricted sales of FY 2017-18.

For FY 2018-19, licensee has considered endorsed deals as affirmed in retail tax order 2018-19. The circle wise and voltage wise LT and HT sales has been segregated in the same ratio as available in actual sales for FY 2017-18.



The licensee has projected the unrestricted sales for the period 4th and 5th control period i.e. for FY 2019-20 to FY 2028-29 with no LR. With the current demand supply scenario, the licensee assumes no load restriction measures for the next control period.

The 1 to 5 year CAGR of the sales growth for the period FY 2012-13 to FY 2017-18 was computed for each consumer category in each circle which is used as a reference for projecting CAGR of respective categories.

The HT and LT unrestricted sales for FY 2017-18 are used as a base for projecting the unrestricted sales forecast using the appropriate growth rates for the period FY 2019-20 to FY 2028-29.

#### **Sales forecast for the control period**

The factors affecting the actual consumption are numerous and often beyond the control of the licensees (policy, individual consumer's conditions, weather conditions, variations in demand-supply conditions of the consumer's product, etc.). Therefore, an accurate point-estimate of the consumption (sales by licensees) is not possible. Under such situation, the attempt is to look into various factors and estimate the inter-relationships and explore various methodologies and analyze the range of results to arrive at a reasonably accurate forecast within a range and use a single point-estimate within the range for the limited purpose of estimating future costs/ revenues.

The methodologies to be used for sales forecast depend on various factors like the segment of consumers for which the forecast is being made, the time horizon of the forecast (short-term or long-term), availability of past data for relevant parameters, the desired nature and the level of details of the forecasts. In order to capture the inherent characteristics of various categories and at different voltage levels, the licensee have prepared the sales forecast on past trends by using CAGR.

capital expenditure is borne by the licensee in order to install new infrastructure such as Distribution transformers, Power transformers, Lines, cables etc.

#### **CAPEX Plan:**

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The additional infrastructure required is estimated using the forecasted peak load at each DTR exit, 33/11 KV exit and EHT SS exit. These peaks are converted into capacities of the systems such as size of the distribution transformer, size of the 33/11 KV transformer and line lengths using diversity factors at each level. Using standard size and cost of the distribution transformer, 33/11 KV transformer and line lengths, the total expenditure is projected.

# Chapter 2

## Literature Review

### 2.1 Importance of power sector

Access to affordable and reliable electricity is one of the primary indicators of economic growth and human development. Power has a major role to play in the sustenance and growth of primary (agriculture, mining, etc.), secondary (manufacturing, construction, textile, metallurgy, etc.) as well as tertiary (railways, IT, healthcare, hospitality, etc.) sectors of the economy. In order to fuel the rapid growth of a developing economy like India, electricity sector experiences the challenge to grow at the same pace as the other sectors. This, coupled with the need for reliable and affordable electricity supply to consumers, requires coordinated efforts by generation, transmission, and distribution and retail supply segments of the electricity value chain.

Capital intensive decisions in the power sector have a direct impact on the welfare of the society, and also have long-term implications for the sector. In a restructured power sector, an independent regulator needs to play an important role to see that system adequacy is ensured to meet the projected demand of electricity. That being said, one of the major roles played by a regulator is regulating the price of electricity such that it is affordable

to the consumers and, at the same time, viable for the suppliers. To achieve this, due consideration should be given to the availability and cost of procured power.

## 2.2 Importance of long-term demand forecasting

Forecasting electricity demand is the first step towards ensuring energy availability and optimising expenses. The importance of accuracy in demand forecasting can also be highlighted from the fact that since electricity cannot be stored economically, its supply must match the demand at all times. Furthermore, generation capacity addition and transmission network augmentation depend on demand forecasts by the DISCOMs, which implies that decisions for large investments depend on this activity. Forecasts can never be absolutely accurate, but higher the accuracy, better it is for the energy sector as a whole. Deviation in long-term forecasts, as reflected in short-term variations, can be addressed to some extent by short-term power procurement and ancillary services. An over-forecast of demand would result in the DISCOM entering into Power Purchase Agreements (PPAs) over and above the required capacity thereby incurring fixed charges for such additional capacity without drawing electricity for the same. This in turn would result in higher consumer tariffs. Since the PPAs are mostly long-term in nature, an over-forecast of demand would imply an inflated retail supply tariff for multiple years. In contrast, an under-forecast would mean unavailability of sufficient power with the DISCOM to meet its obligation of satisfying the end-consumer demand, resulting in frequent load shedding. This might also attract penalties where strict Standards of Performance (SoP) norms are in place. Moreover, consumers who require reliable supply would have to opt for Diesel Generator (DG) sets which are neither economical nor environment-friendly. Inaccurate demand forecast may also cause disproportionate capacity additions resulting in stranded assets, thereby placing the investors' capital at risk. Such situations also lead to inappropriate policy formulations. The above scenario evidently leads to the conclusion that a robust mechanism must be put in place to ensure proper long-term demand forecasting and power procurement planning for efficient operation of the sector.

## 2.3 Existing legislative and policy provisions in India

Electricity finds place in List-III (Concurrent List) of Seventh Schedule of the Constitution of India. Thus, the subject of electricity is under the joint jurisdiction of Governments in all States and Union Territories (UTs) and the Central Government. In other words, both State and Central Governments have the power to formulate legislations on the subject of electricity. Presently, the main overarching umbrella guiding all activities in the Indian power sector is the Electricity Act, 2003 (hereinafter referred to as the Act). In fulfillment of its obligations under The Act, the Central Government came up with National Electricity Policy (NEP) (2005) and National Tariff Policy (NTP) (2006, later amended in 2016). Each of these policy instruments emphasizes improvement of financial efficiency of the sector by optimizing the overall cost of its functioning in general, and power procurement by DISCOMs in particular.

### 2.3.1 Electricity Act, 2003

The Act does not explicitly refer to long-term demand forecasting but empowers the ERCs to regulate power procurement [32]. However, the Preamble of the Act clearly specifies promotion of competition in the sector, tariff rationalisation, efficiency in operation, protection of interests of consumers and other stakeholders, supply of electricity to all areas, etc. Accurate demand forecasting and efficient power procurement planning would considerably help achieve these objectives. Clause 61 (c) of the Act states that the State/Central/Joint Electricity Regulatory Commissions (SERCs/ CERC/JERCs), as and when required, must consider encouraging competition, efficiency, economical use of resources, better performance and optimum investments while determining the tariff, whereas clause 61 (d) emphasises protection of consumers' interests and cost-recovery in a reasonable manner. The Act also empowers ERCs to determine the tariff for licensees (clause (1) of Section 62) and regulate the power purchase process as well as tariff for the utilities (clause (1) (b) of Section 86). Section 73(i) entrusts Central Electricity Authority

(CEA) to carry out studies pertaining to cost, efficiency, competitiveness and associated matters which implicitly refers to load forecasting and power procurement planning.

### **2.3.2 National Electricity Policy, 2005**

NEP targets setting rules to quicken the improvement of power sector in the nation, give power supply to all zones, and ensure the interests of purchasers and different partners of the sector, while considering the accessibility of energy and technological resources, accessible to exploit these resources, financial aspects of electricity production using multiple resources. NEP likewise targets providing reliable and quality power (of determined standards) in a productive way at sensible rates. Clause 3.2 of NEP also directs CEA to make short-term and long-term demand projections.

### **2.3.3 Tariff Policy, 2006**

The Tariff Policy (TP), 2006 envisioned electricity access to all consumers in an economic, efficient and reliable manner with transparent, consistent and predictable regulatory practices minimising the perceived regulatory risks [34]. However, it is silent on demand forecasting or power procurement planning.

### **2.3.4 Tariff Policy, 2016**

The revised Tariff Policy [35], in addition to meeting its earlier objectives, also directs the ERCs to mandate the DISCOMs to forecast their load and plan their power procurement annually on a rolling 26 basis. Clause 8 of the Policy states that “The appropriate Commissions must mandate DISCOMs to undertake the exercise of load forecasting and power procurement planning every year”. Although NEP directs CEA to make short-term and long-term demand forecasts, it does not refer to the role of demand forecast

in power procurement planning by the distribution utilities. In practice, many distribution utilities (or the holding companies, on their behalf) undertake the task of long-term demand forecasting and power procurement planning. The SERCs either rely on CEA's forecasts or adopt a view whereby the distribution licensees or the holding companies are required to undertake long-term demand forecasting and presenting the results before the Commission. Tariff Policy, 2016 addresses the lacunae in TP, 2006 by including a provision mandating the DISCOMs to undertake demand forecasting and power procurement planning annually. Under the existing framework, several SERCs have directed the utilities regulated by them to prepare power procurement plans based on long-term demand forecasts. These ERCs adopted an altogether different approach by largely following the spirit of TP, 2016.

## 2.4 Long-term demand forecasting in Andhra Pradesh

The electrical energy and demand estimates made in the EPS Reports for Andhra Pradesh were significantly different from the actuals realised thereafter. However, the state projections were highly realistic. 4. Long-term Demand Forecasting and Power Procurement Planning – Existing Practices across States 1 State Electricity Board (SEB), transmission and bulk supply company or DISCOM as the case may be. 2 For the consolidated state of Andhra Pradesh till 2014, and the newly formed states of Andhra Pradesh (AP) and Telangana (TS) thereafter. 32 Andhra Pradesh Electricity Regulatory Commission (APERC) issued Guidelines for Load Forecasts, Resource Plans and Power Procurement in December, 2006 [36]. According to these guidelines, transmission and distribution licensees are required to submit their load forecasts over a ten-year period to the Commission, pursuant to Regulation 17.12 of the Transmission and Bulk Supply Licence Regulations [37] and Regulation 19.2 of the Distribution and Retail Supply Licence Regulations [38]. However, the guidelines do not specify the methodology to be followed for forecasting. Transmission Corporation of Andhra Pradesh Limited (APTRANSCO) is required to collect and

consolidate the forecasts of the distribution licensees and submit them with suitable adjustments, if any, to APERC. The licensees are required to submit their load forecasts in three categories: a) A detailed forecast for the first five-year control period b) A simple forecast for the subsequent five-year control period c) Historical information and data relevant to the load forecast Part II of the APERC Regulation No. 4 of 2005 and APERC Regulation No. 5 of 2005, which deal with the Terms and Conditions for Determination of Tariff for Wheeling and Retail Sale of Electricity, specify that the transmission licensees are required to file before APERC a resource plan comprising the load forecasts, on 1st April of the year preceding the first year of commencement of the control period [39]. Regulation 35 of the APERC Distribution Licence Regulations (Regulation No. 10 of 2013) [40] specifies that the distribution licensees shall prepare and submit to APERC a year-wise demand forecast for its area of supply for two consecutive control periods. It is also stated that the distribution licensees shall purchase electrical capacity or energy in an economical and efficient manner under a transparent power procurement process.

## 2.5 Regulatory framework in Andhara Pradesh

The Andhra Pradesh Electricity Regulatory Commission promulgated the guidelines for Load Forecasts, Resource Plans and Power Procurement Plan in December, 2006 in the place of earlier guidelines in existence. The APERC (TC for Determination of Tariff for Wheeling and Retail Sale of Electricity) Regulation, 4 of 2005 made it compulsory by Clause 9 the reporting of a resource plan of the Sales and Load prediction, Power Procurement Plan and a Distribution Plan (Capital Investment Plan) by the Distribution Licensee to the Commission which is in accordance with the Commission's regulations on Load Prediction and Resource Plan as amended now and then. Clause 9.2 further mandates that the Commission shall approve the Resource plan as per the Guidelines and the Distribution Licensee shall adopt them in the Multi- Year and Annual filings for the Control Period. As per Clause 16 of the Regulation, the Commission has to adopt



the Capital Investment Plan as part of the Resource Plan in terms of Clause 9 for determining the Regulated Rate Base (RRB). The Andhra Pradesh Electricity Regulatory Commission (Terms and Conditions for Determination of Transmission Tariff) Regulation 5 of 2005, in Clause 9, similarly made it mandatory for the Transmission Licensee to file a Resource Plan before the Commission which contains the Load Forecast and a Transmission Plan (Capital Investment Plan) consistent with the requirements of the Guidelines on Load Forecast and Resource Plan as approved by the Commission from time to time. Clause 9.2 lays down that the Commission shall approve the Resource Plan as per the Guidelines and the Transmission Licensee shall adopt them in the Multi-Year filings for the Control Period. Clause 14 of the Regulation mandates the Commission to adopt the Capital Investment Plan approved as part of the Resource Plan in terms of clause 9 for determining the Regulated Rate Base (RRB). The Andhra Pradesh Electricity Regulatory Commission (Terms and Conditions for determination of tariff for supply of electricity by a generating company to a distribution licensee and purchase of electricity by distribution licensees) Regulation, 1 of 2008 directs in Clause 3, the Distribution Licensee to prepare a Power Procurement Plan as per the Commission's Guidelines on Load Forecasts, Resource Plans and Power Procurement to be submitted for the Commission's approval as specified in Clause 9 of Regulation 4 of 2005. The Andhra Pradesh Electricity Regulatory Commission (Distribution License) Regulation, 10 of 2013 provided in Clause 35 that the Distribution Licensee shall prepare year-wise demand forecast for two control periods in accordance with the guidelines/regulations issued by the Commission from time to time and the Distribution Licensees shall also submit prospective power procurement plan and Distribution Plan. Clause 37 of the Regulation provides for the Licensees submitting long term investment plan for 10 years including detailed investment plan for 5 years, year by year in accordance with Load Forecast and Demand Forecast.

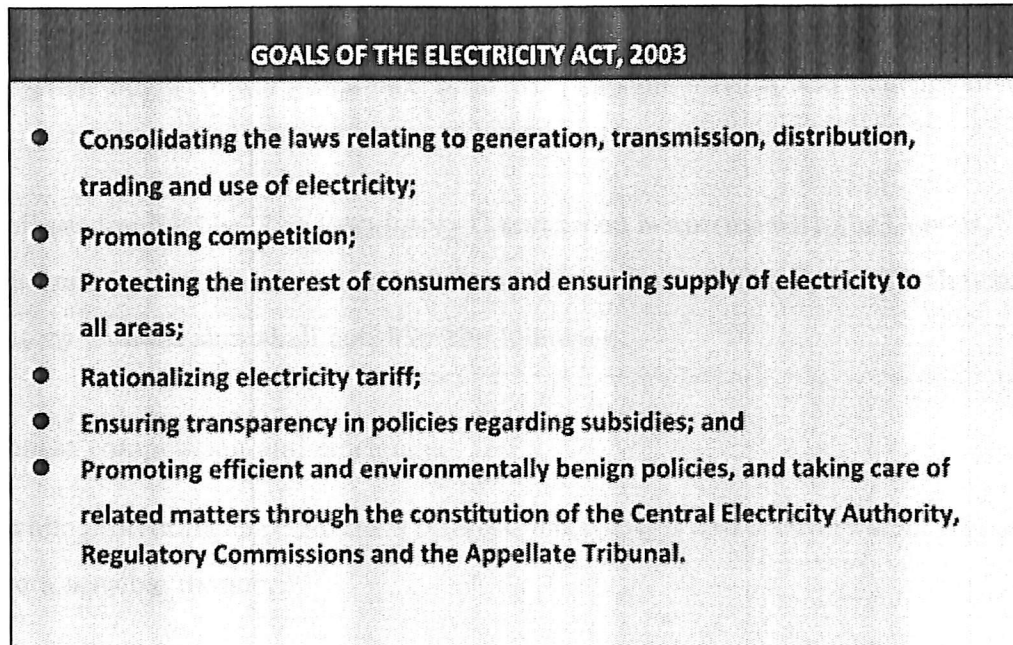


FIGURE 2.1: GOAL OF ELECTRICITY ACT,2003

## 2.6 Acts and policies of India's power sector

Electricity act,2003: the essential goal of this act is to present competition among different power generation organizations, in order to decrease the expense of produced electricity, increment efficiencies and pass on the advantage to the buyer over the long haul.

### **Salient features of the electricity act, 2003 relevant to tariff determination:**

In consideration to chapter vii of the act, tariff is constant. Fixing the tariff has become straight forward and is protected from the external pressures like political, bureaucratic and so on. ERCs are given authority to determine the tariff's terms and conditions following the measures based on the competition, efficiency, resource finances etc. Under multi-year tariff system, utilities are relied upon to design deals and investment 3 to 5 years ahead. Multi-year tariff system ought to accommodate tariff path, income stream and venture plans of the utilities. ERCs will decide tariffs for supply by generation companies to distribution companies, for transmission, wheeling, and retail sales. They are enabled to fix limits for trading and can embrace mechanisms of deciding tariff through

bidding. One cannot amend the tariff for less than three to five year period. Multi-year tariff system ought to accommodate tariff way, income stream and utilities investment plans.

**Guidelines for ERCs:** The Regulatory Commission is worried with the Gencos, Transcos and Discoms operating on commercial lines. While determining the tariff, the concerned Regulatory Commission shall consider the following:

- boost competition and efficiency;
- while protecting the customers interest, electricity's cost recovery shall be performed in a sensible manner;
- encourage electricity generation through renewable energy sources;
- check the measures that would encourage efficiency and the optimal use of the available resources; and
- make sure that the companies of generation, transmission and distribution conduct business based on the commercial values.

The Regulatory Commission in the wake of getting proposal for tariff should give wide attention to the proposal before the tariff determination and welcome open issues with the tax proposition, assuming any. Section 65 of the Electricity act ensures that the Government need to pay advance to the companies if it needs any additional subsidy other than the one determined by the commission to customer or class of customers so that government cannot make empty promises to convince some category of the customers. If the government wants to be extra-generous to some customers, it needs to provide additional grants as subsidies to the power companies.

### **Subsidy - Cross-Subsidy**

The Act ensures that the state governments shall give subsidies to the state electricity regulation committees in advance, if it is not provided to the customers on its direction.

The state governments decisions are not operative if subsidies are not given in advance. Elimination of cross-subsidies in tariff must be attempted in a progressive manner.

In a non-oppressive open access of transmission and distribution systems, there must be payment of extra charge until the cross-subsidies are disposed of.

### **Restructuring**

Option is in the hands of the state governments to continue with the state electricity boards which are then be considered as Distribution Licensees and the STU owns the assets of the electricity generation. It is allowed to provide one year duration for the transition of the existing licensees. State Governments have rights to defer the application of the Act for half a year at maximum.

### **Cross Holdings**

Generation companies are allowed to undertake the Businesses of the Distribution companies and the vice versa is also possible.

### **Theft and Other Offences**

All the electricity companies are suffering from the vital problem: electricity theft. The Electricity Act, 2003 ensures strong penalties for the one who steal the electricity and the offence is culpable under the Indian Penal Code (IPC) which imprisons the one for upto a period of three years and/or fine. These punishments are for all kinds of theft direct, tampering of electricity meters and for using the energy in fraudulent manner.

For the unauthorised usage of the electricity, customers will be professionally inspected by an inspecting officer under the Electricity Act, Section 126 and an order of the assessment is provided to the customer allowing him/her for making any objections. After that, if that customer pays the assessed amount, she/he cannot be subjected with any action or liability by an authority.

For the categories of the agriculture and domestic, if an inspecting officer finds an unauthorized usage of electricity, it will be considered that the customer is performing this act

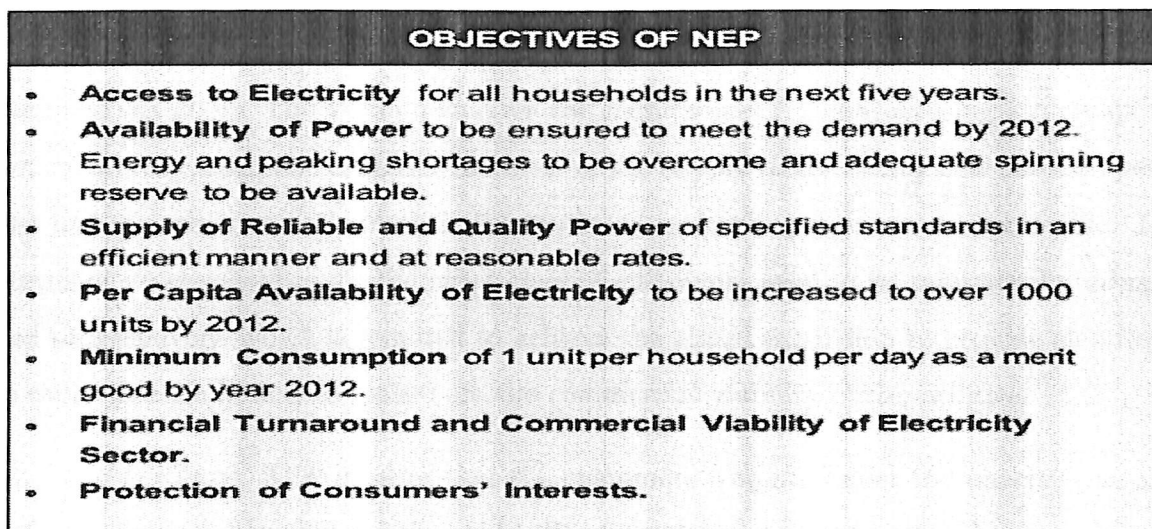


FIGURE 2.2: Objectives of Electricity Policy

for last three months, under the guidelines of the Section 126(5). On the other hand for the categories other than the above mentioned, it will be considered that the customer is performing this act for last six months.

### National Electricity Policy (NEP):

The NEP is the pivotal policy containing the force of law under the Electricity Act, 2003. Both the Central and State Electricity Regulatory Commissions shall work under the NEP. A Nation wide Electricity Plan shall be built by the Central Electricity Authority following the guidelines of the NEP. NEP targets the fast growing of the power sector while providing quality electricity supply to all the parts of the country along with safeguarding the interests of the customers and the stakeholders considering the availability of the resources like energy and technology, economics of generation using various resources and the security measures.

### Important Features of NEP

**Access to electricity:** The NEP ensures that every citizen will get access to electricity. Moreover, it also emphasizes that every customer, specifically who are willing to pay tariff which mirrors the efficient costs must get the uninterrupted power supply.

**Targeted subsidies: The NEP**

Targeted subsidies: The Policy perceives the requirement for guaranteeing the recuperation of service costs; the expenses incurred in the supply of electricity and related operation and maintenance costs from the customers to make the power sector sustainable. The prevalent cross-subsidies for the other class of customers need to be minimized gradually and progressively, which is required to achieve the aimed expansion to provide electricity to every household and to make sure the commercial viability of the utilities.

On the other hand, NEP ensures that the customers who are under the poverty line and utilize below a predetermined threshold (like 30 units in a month), shall be given special support as cross-subsidized tariffs and those tariffs shall be at least half of the total supply. Moreover, the State Governments have the power to provide discounts and subsidies to any other class of customers following the provisions in the Act where they shall reward the power utilities with the State budget.

Circumventing power shortages: the policy targets at balancing both energy and peak demand completely by 2012 alongside making spinning reserves upto 5% at the country level. Moreover, NEP emphasizes complete development of clean and renewable energy sources like hydro-potential. Further, by harnessing the hydro-potential, it helps in the financial growth of the states for ex. north-east states as they contain large hydro-power resources. The policy gives importance to the necessity of the debt financing for longer duration for the hydro projects to ensure them more financially viable.

Though the feasible hydro potential is developed, the NEP recognizes that the nation needs to depend on thermal power generation to a major extent to meet the future power demand. Though the choice of fuel is grounded on the finances of the power generation and supply, coal shall remain as the major fuel considering the security requirements. Moreover, power generation through natural gas can also be developed but it is completely dependent on the availability of the resources at the reduced prices.

The policy prioritises the need to harness the additional capacity produced from captive generation plants using the power grids to circumvent the electricity shortages. This can be achieved by maintaining the the commercial alignments among distribution licensees and the captive generators. It can be observed in Chapter 1 that the substantial captive generation capacity has been set up during the past years and there is a considerable surplus captivity is available through this source.

**Transmission:** the NEP underlines that satisfactory and opportune venture alongside productive and facilitated activity is important for building up a vigorous and incorporated power framework in the nation. There is a need to expand transmission limit in perspective on the gigantic increment arranged in generation and furthermore for encouraging advancement of power markets. NEP envisions that the transmission limit ought to be arranged and worked by global principles and rehearses and ought to take into account both the excess levels and margins.

Under the directions of the policy, a country level transmission tariff system will be executed by CERC for encouraging savvy transmission of power over the areas. The tariff system must fuse distance, direction and the quantum of stream of power, and keep up consistency in the transmission valuing structure in between state and intra-state frameworks.

Moreover, the Regulatory Commissions are ordered by the policy to encourage non-oppressive open access and decide transmission charges in the mentioned time period for benefiting such access. Fundamental modernization of the load dispatch facilities would be attempted in a time bound way to accomplish this goal.

**Distribution:** The policy calls for appropriate rebuilding of distribution utilities which has been considered as a pivotal part of the electricity business, for accomplishing productivity gains. It lays exceptional accentuation on time bound decrease of transmission and distribution losses and promotes competition targeting customer benefits.

Multi-Year Tariff (MYT) was given in Electricity Act, 2003 and is a key incentive in reducing the risks for utilities and customers by advocating efficiency and providing drift reduction of losses in the system.

**Role of ERCs:** The NEP is one of the most important contraptions to impart policy guidance to the Electricity Regulatory Commissions to perform their duties and the Central Electricity Authority in planning the National Electricity Plan.

Considering the pre-decided indices on the quality of the power supply, the Regulatory Commissions have been directed to regulate the utilities.

The Regulatory Commissions have been mandated to regulate utilities on the basis of pre-determined indices on the quality of power supply. These criteria may be breakdown frequency and period, time to resume supply, percentage of faulty meters, and holding list of new connections. The policy visualizes drawing up a guide for assertion of Reliability Index (RI) of power supply to customers for all urban areas and rural areas and that data will be incorporated by CEA for publishing purposes. This is necessary to set up standards to improve and drag in competition.

State Electricity Regulatory Commissions (SERC) would embrace isolation of technical and commercial losses via energy audits and it is essential to publish those results before March 2007. The SERCs should also mention the benchmarks for power reliability and quality so that they are in accordance with the global practices by the year 2012.

**Financing the power sector projects:** A huge investment - an estimation of about INR 9 lakh Crores in upcoming decade - is required for the aimed expansion of the sector. Because electricity is the pivotal infrastructure, investments shall be received from public sectors: both central and state level.

Further, as public sector investments alone may not be sufficient, NEP visualizes that private sectors shall invest a considerable part. Public investments shall concentrate on peoples service obligations like improved access to the power and giving electricity to the small and marginal farmers.



To make the sector viable and also attractive for fresh investments, the policy emphasizes the need of ensuring that the generating companies, transmission and distribution licensees receive payments due to them. To gather significant investments from the private sectors, the NEP suggests following steps:

1. Advocation of competition in various segments;
2. Acquisition of power by competitive bidding; and
3. Significant measures to empower private sector investments in transmission.
4. Additionally, NEP allows for some of the existing generating capacity to be sold outside of long-term power purchase contracts to encourage competition.

#### **National tariff Policy:**

The Union Government announced the National Tariff Policy (NTP) on the 6th of January, 2006 to the Power Sector in accordance with Section 3 of EA, 2003. By declaring NTP 2006, a clear picture of the broad rules to be considered for the tariff fixation. Both Central and State Electricity Regulatory Commissions are administered by the NTP to fix tariffs on generation, transmission and distribution, and it shall be understood that the NTP shall not demote the role of Regulators by significantly distinguishing the role of Government and the Regulators. It drives CERC responsible to allow standard procedures in tariff determination and also gives the methodology more transparent to Regulators.

The Regulatory Commissions would put an arrangement of autonomous examination of money related and technical information put together by the licensee. They have likewise been called upon to energize reasonable neighborhood impetus and disincentive plans for the staff of the utility connected to minimize losses. Verification results done by external for of energy audit are to be utilized to force region explicit extra charge for bigger losses. More prominent transparency and supporting customer groups will be the important component of regulatory procedures.

The objectives of the NTP are as follows:

1. Guarantee accessibility of power to purchasers at competitive and sensible;
2. Make sure economical viability practicality of the power area and draw in investment;
3. Encourage the transparency, consistency and predictability in regulatory mechanisms across jurisdictions and reduce regulatory risks; and
4. Encourage competition, efficiency in operations and enhancement in quality of power supply.

The NTP prioritizes to make a decision on the rate of return, depreciation, and other related things that are necessary to determine the tariff and bring investments. One shall do this by reducing the “regulatory risk” and bringing transparent tariff setting guidelines.

**Cross-subsidies:** The NTP demonstrates transparency while fixing the cross-subsidy and extra charges to allow access to customers and puts a timeframe for rationalization of power tariffs and minimizing cross-subsidies. Further, it also formulate the calculation of cross-subsidies.

Customers under the poverty line and using a small amount of power shall continue to avail special support in the form of cross-subsidised tariffs. To provide an option of power supply to the customers, the tariff policy

Consumers below the poverty line and consuming a small quantity of electricity shall continue to receive special support through cross-subsidised tariffs. To give a choice of supply to the consumers, the tariff policy provides facilitative framework to compute the cross-subsidy surcharge. Moreover, it also provides a mechanism to provide alternate supply to such customers.

**Multi-year tariff:** The multi-year tariff (MYT) system is to be considered for any tariffs to be resolved from April 1, 2006 additionally with incentives and additional charges for better execution . The step towards MYT also considers regulatory certainty. Then, an investor can learn with decent probability about the future steps and the direction of

tariffs making nice investment decisions and the profits from the efficient operations are to be distributed to customers as well. If there is any inefficiency it must be regulated and penalized.

**Competition:** The tariff policy bolsters competition by making it mandatory for a distribution licensee to procure power through competitive bidding by promoting captive power, open access and encouraging multiple players. The policy ensures that the Returns on Investments shall be tangential to the other sector and they should be grounded on the norms and achievements. Incentives must be given to encourage investors to be efficient.

**Non-conventional energy:** The policy encourages energy sources that are non-conventional and co-generation by mentioning the least percentage. The project developers are provided with enough incentives to gain the advantages of the Clean Development Mechanism (CDM). The expense of the project shall let enough finances to setup coal washeries, beneficiation system and, ash handling and disposal systems.

**Service standards:** The forum of regulators (constituted by the central government for consistency in regulation in the area of distribution) will decide the basic framework of service standards so that the standards regarding quality, continuity and reliability of service can be enforced. Licensees who could not able to reach this standard shall be penalized.

**Agricultural users:** To consider the problems about the sustainable use of the ground water, the agriculture tariffs must be fixed to certain value. However, free power supply shall not be given as it allows possibility of irresponsible power consumption making depletion of the water table. Time based tariffs are to be set up with in a year for big customers of 1MW and more to encourage energy efficiency.

**Other features:** For projects whose tariff is resolved by execution based expense of service guideline, the advantage of diminished tariff after full devaluation of assets is to be provided accessible to the customers. Similarly, to avoid front loading of tariff,

For projects whose tariff is determined through performance- based cost of service regulation, the benefit of reduced tariff after full depreciation of assets is to be made available to the consumers. Correspondingly, for maintaining a strategic distance from front loading of tariff, obligation of longer tenor and selection of mechanisms like take-out financing are to be examined. Debt returns are to be performed considering the interest of large amount of customers. Any extra capital investments for infrastructure is to be attached with the estimated efficiency gains or for high level performance.

To increase grid discipline, the accessibility based tariff framework is to be reached out to the state level. This will likewise encourage joining of captive generation plants with the grid.

## **2.7 About APSPDCL (Sponsoring Organization):**

Andhra Pradesh Power Sector Reforms visualizes the establishment of Power Distribution Companies as undertakings of the Government sector initial period and would be privatized later. The Gazette No.37 (31st Mar, 2000) of government of AP formally announced the establishment of Distribution Companies and APSPDCL was created for the six major districts of AP headquartered at Tirupati.

Providing quality electricity at reasonable prices helps in steering the state to foster improvement in agriculture, commercial and industrial sectors along with reaching the increase in domestic requirements. On the 1st of February 1999, the government of Andhra Pradesh started the initial phase of reforms and reconstruction states power sector by splitting state electricity board into APGENCO and APTRANSCO to meet the requirement of generation, transmission and distribution. Later, APTRANSCO was divided into 4 distribution companies for various districts.

APSPDCL was established in 1st April, 2000 to meet the requirements of the people living the districts of Krishna, Guntur, Prakasam, Nellore, Chittoor and Kadapa with

an aim to be an efficient utility to provide reliable and quality power. Currently, after the bifurcation of the state into two, APSPDCL expanded its services to Kurnool and Anantapur districts.

APSPDCL DISCOM Details up to 31-03-2019

TABLE 2.1: APSPDCL's details

SNO	DETAILS	
1	Area in Sq. KM	118119
2	#Domestic Services	7850093
3	#Non Domestic & Commercial Services	783959
4	#LT Industrial Services	75736
5	#Cottage Industries and Dhobighats Services	12366
6	#Agricultural Services	1265897
7	#P W S & Street Light Services	105230
8	#General Purpose Services	63764
9	#Temporary Services	65
10	#LT Services	10157110
11	#HT Services	6528
12	#220 KV Substations	70
13	#132 KV Substations	143
14	#33/11 KV Substations	2184
15	#Distribution Transformers	716844
16	#11 KV Feeders	8435
17	#33 KV Feeders	1036
18	#Divisions	49
19	#Sub-Divisions	168
20	#Sections	649
21	#ERO s/SUB-ERO s	131

## 2.8 Summary:

The Electricity Act, 2003 spans over most important issues considering generation, transmission, distribution, and trading of electricity. Though a small portion of the sections were implemented earlier, a significant portion of the sections are to be implemented to the full extent.

Regulation 4 of APERC mentions that the licensee has to file Aggregate Revenue Requirement (ARR) for Distribution Business and Retail Supply Business in addition to the Filing for Proposed Tariff (FPT) to recover the ARR for the entire control period.

The APSPDCL has been following the following the regulations, policies and practices for Distribution and Retail supply business. After the issuance of various regulations by APERC regarding the filing of ARR, MYT and Resource plan, APSPDCL has been able to file the respective petitions after intensive study and by adopting standard practices in estimating and projecting various line items.

## Chapter 3

# RESEARCH DESIGN, METHODOLOGY AND PLAN

### 3.1 Data Sources

The Analytical Research for this project has been planned to predict future capital expenditure of the Discom. In analytical research, facts or information already available is used to make a critical evaluation of capital expenditure. The primary data is collected from the various wings of APSPDCL based on capital expenditure likely to be incurred in providing reliable and quality of supply to the consumers in line with peak demand of upcoming years and various developmental activities in technological up-gradation and loss reducing strategies in-line with standard norms and targets existed in vogue.

## 3.2 Research Design and Methodology Sales Projection:

Sales the period FY 2012-13 to FY 2017-18 has been used as the base for estimating and projecting the sales of the upcoming years. The table 3.1 captures the historical sales for the licensee and the 3-year and 6-year annual growth rate (CAGR).

TABLE 3.1: historical sales for the licensee and the 3-year and 6-year annual growth rate

LT Category	FY 2012-13	FY 2013-14	FY 2014-15	FY 2015-16	FY 2016-17	FY 2017-18	CAGR
LT-I Domestic	5,155	5,436	6,133	6,954	7,599	8,167	9.60%
LT-II Non- domestic/Commercial	1,212	1,221	1,360	1,551	1,656	1,750	7.60%
LT-III Industrial	1,209	1,113	1,428	1,466	1,686	2,038	11.00%
LT-IV Cottage Industries	30	30	34	37	40	40	6.40%
LT-V Agriculture	7,018	8,010	8,362	8,480	9,269	8,640	4.20%
LT-VI Street Lighting & PWS	566	491	517	540	639	700	4.30%
LT-VII General Purpose	71	70	81	89	96	101	7.40%
LT-VIII Temporary Supply	1.1	1.2	23.6	0.7	1.5	1.3	2.30%
LT Total	15,262	16,373	17,939	19,116	20,986	21,438	7.00%
HT Category							
HT-I Industry	5,208	5,741	6,792	7,269	6,586	6,455	4.40%
HT-I (B) Ferro-Alloys	201	340	434	236	301	398	14.70%
HT-II Others (Commercial)	474	498	562	693	703	774	10.30%
HT-III Public Infrastructure and Tourism	1	11	20	22	49	56	38.60%
HT - IV Agriculture	124	345	565	339	1,011	1,079	54.20%
HT-V Railway Traction	610	652	752	693	650	740	3.90%
HT-VI Townships and Residential Colonies	48	41	38	42	35	26	-11.70%
HT-VII Green Power	0	0	0	0	0	0	0.00%
HT-VII RESCOs	239	265	284	298	413	369	9.10%
HT-VIII Temporary Supply	0.28	0.67	0.91	0	0.07	0.48	11.40%
HT Total	6,905	7,894	9,446	9,593	9,748	9,897	7.50%
LT+HT Total	22,167	24,267	27,385	28,710	30,734	31,335	7.20%

### Sales Forecast

The licensee has projected the sales for ensuing years by using compounding average growth rate (CAGR) duly using the above unrestricted sales of FY 2017-18.



For FY 2018-19, licensee has considered approved sales as approved in retail tariff order 2018-19. The circle wise and voltage wise LT and HT sales has been segregated in the same ratio as available in actual sales for FY 2017-18.

The licensee has projected the unrestricted sales for the period 4th and 5th control period i.e. for FY 2019-20 to FY 2028-29 with no LR. With the current demand supply scenario, the licensee assumes no load restriction measures for the next control period.

The 1 to 5 year CAGR of the sales growth for the period FY 2012-13 to FY 2017-18 was computed for each consumer category in each circle which is used as a reference for projecting CAGR of respective categories.

The HT and LT unrestricted sales for FY 2017-18 are used as a base for projecting the unrestricted sales forecast using the appropriate growth rates for the period FY 2019-20 to FY 2028-29.

APERC Regulation 4 of 2005 gives that "Every Distribution Licensee will file for each of its licensed business an application to get approved of its Aggregate Revenue Requirement (ARR) for every year of the Control Period

ARR and Tariff fixation for the each year of the control period is contemplated to be determined at one time in advance for the entire five year period. The accurate projection of the controllable costs in Multi Year Tariff will reflects the accurate Distribution cost in Aggregate Revenue Requirement (ARR) filing. The accuracy in the projection of the controllable items of the Multi Year Tariff will eliminates the process of True-up petition of Licensee towards the recovery of his actual expenditure for the entire control period. In addition to that it will also eliminate the creation of regulatory asset and its carrying cost.

The CAPEX is one of the hidden cost items that are taken into consideration while calculating the distribution cost in Multi Year Tariff filings of a DISCOM. The capital expenditure of DISCOM is based on the estimation of the expenditure towards network

development, infrastructure development and technological up gradation in the Resource plan of particular control period.

The CAPEX is the one of the major expenses in the DISCOM's Distribution cost. The accurate estimation and projection of capital expenditure in Resource plan will recover the near to exact Distribution cost in ARR. In addition to that, it will also eliminate the burden to the future consumers in bearing the revenue gap arrived because of difference of the actual expenses and approved expenses of the previous control period.

Research is carried out by estimating additional infrastructure requirement using the forecasted peak load at each DTR exit, 33/11 KV exit and EHT SS exit. These peaks are converted into capacities of the systems such as size of the distribution transformer, size of the 33/11 KV transformer and line lengths using diversity factors at each level. Using standard size and cost of the distribution transformer, 33/11 KV transformer and line lengths, the total expenditure is projected.

The table 3.2 gives the circle wise growth rates considered for each consumer category.

The forecasts thus arrived at have been looked at as a guiding value for modification to the trend based forecasts. The growth rates adopted for all the categories is based on the circle wise CAGR obtained from FY 2012-13 to FY 2017-18.

The growth rates are applied on unrestricted sales considering the actual sales during FY 2017-18.

For LT-I Domestic category. CAGR that has been considered accounts for increase in demand in domestic category because of fewer load restrictions, 24 hours of power supply to rural areas and industrial clusters.

The growth rate in Vijayawada Guntur circles for LT Cat-I LT Cat-II have been increased by 3% over historical growth rate in order to factor in the formation of Capital City. The growth rate in 11KV HT Cat-I Industrial in Guntur circle is also increased by 3% in order to factor in the upcoming industrial loads. The growth rate of LT Cat-V in Vijayawada

Guntur circles is considered as 2% considering the historical growth rates and the increased urbanization.

LT Industrial category which has recorded phenomenal growth rates in certain Districts particularly Vijayawada Nellore. has been critically reviewed and the CAGR for the forecast period is moderated and adopted as around 20%.

There is an anomalous growth in HT Lift Irrigation schemes pertaining to the life irrigation schemes. But, in the future there would not be any steep growth once the schemes have been commissioned, except normal operations until new projects are implemented. The growth rate in HT Lift Irrigation Schemes has been considered as 2%.

For HT-I (Industrial) and HT-II (Commercial) categories, CAGR that has been considered accounts for increase in demand from industrial clusters.

Railway Traction RESCOs have been considered in accordance with the normal trends.

Overall the historical CAGR for sales (FY 2012-FY 2018) is 7.17% and the CAGR for the forecast period (FY 2018-24) is 8.4%.

The table 3.3 below summarizes the category-wise sales projection in MUs for the period FY 2017-18 to FY 2023-24.

### **Load forecast (MU)**

The sales forecast output has been considered for projecting the load requirements for the next two control periods. The sales forecast output would be adjusted for the LT losses, 11 KV losses, and 33 KV losses. The total gross energy required at 33 KV voltage level is added to the sales at 132 KV voltage level to arrive at the total energy required at 33 KV + 132 KV voltage level. The Power procurement plan would be tied up with the load requirement and checked for any surplus or deficit.

The circle wise sales output from the sales projection sheet for the next two control period was taken and the sales figure were adjusted for the losses as per the loss trajectory to arrive at the load requirement for the 4th and 5th control periods.

Table 3.4 shows APSPDCL Sales projections (Grossed up with losses) for 4th Control Period

### Load Forecast (MW)

Once the Sales forecast and Energy requirements duly taking into consideration Voltage wise losses are finalized, the next step in the planning exercise is to estimate the Peak Demand that is going to be experienced by the individual DISCOM that adds up to the State Grid Demand.

Sales forecast in energy terms along with other technical factors concerning the Load pattern of Circles and aggregate at the DISCOM level are used to assess likely Peak Demand / Coincident Demand for the purpose of system planning and Power procurement planning.

The projections on Circle wise/DISCOM wise peak demands are necessary for the purpose of projection of required Capital expenditure for the forecasting period and more particularly projection of Power Purchase requirement and procurement planning.

Circle wise Peak Demand projection - for the purpose of Capital expenditure in the circles to meet the Demand

DISCOM Peak Demand projection for the purpose of Power procurement planning.

The licensee has collected District wise hourly demand recorded /observed at EHT level for the base year 2017-18 to capture the monthly variations in the load pattern. The annual Load Factors for each district and monthly load factors at DISCOM level have been calculated, based on the hourly load pattern in FY 2017-18, and have been used to estimate peak demand of each circle and the DISCOM respectively.

Following table summarizes the annual Load Factors of each district/circle and the DISCOM. The same Load factors have been adopted to estimate the Peak Demand throughout the planning period of 4th 5th Control periods for the respective circles.

Table 3.5 shows the calculated co-incident load factors for all circles in APSPDCL.

Basis, the above assumed load factor and energy required arrived at 132 KV level as per section 1.3, licensee projected the demand in MW for all the years in 4th and 5th control period. The circle wise co-incident demand is summarized in the tables below.

Table 3.6 shows the Co-incident peak demand required for 4th Control Period

### **Capital expenditure required for additional infrastructure**

Additional capital expenditure is borne by the licensee in order to install new infrastructure such as Distribution transformers, Power transformers, Lines, cables etc. The additional infrastructure required is estimated using the forecasted peak load at each DTR exit, 33/11 KV exit and EHT SS exit. These peaks are converted into capacities of the systems such as size of the distribution transformer, size of the 33/11 KV transformer and line lengths using diversity factors at each level. Using standard size and cost of the distribution transformer, 33/11 KV transformer and line lengths, the total expenditure is projected.

### **Detailed Methodology**

In each circle of the licensee, the energy requirement (in MU terms) at each of the LT, 11 KV, 33KV and 132 KV level is taken from sales forecasts for 4th and 5th control period. Licensee has predicted the MW peak demand in each circle wise peak demand (in MW) for 4th and 5th control period at 33KV + 132KV voltage levels. Basis, the peak demand arrived at 33KV + 132KV voltage levels, the peak at DTR exit, 33/11 KV SS exit and 132/33 KV SS exit are calculated using the sales contribution of at each of these voltage levels.

Based on the peak demand arrived at each year, the incremental peak demand required at each subsequent year compared to previous year is calculated. Below table shows the incremental peak demand required at each circle for DTR exit and 33/11 KV exit from FY 2018-19 to FY 2028-29.

The peak demand (in MW) arrived at DTR exit and 33/11 KV SS exit is converted to MVA by using the diversity factor at both DTR and PTR level.

Diversity factor is the ratio between transformation capacity and peak demand at the SS level. Diversity factors for DTR is calculated as the ratio of total DTR capacity in MVA divided by the expected peak demand at LV level. Diversity factors for PTR is calculated as the ratio of total PTR capacity in MVA divided by the expected peak load at 11KV voltage level. The ratio is rounded to the next integer level for the sake of simplification and to accommodate planning margins. For APSPDCL, the diversity factor thus arrived are 5.61 for distribution transformer and 3.07 for 33/11 KV power transformer. However, the diversity factors are moderated to 4 for distribution transformer and 2.5 for 33/11 KV power transformer in view of the idle capacity prevalent in the system.

Tables 3.7 3.8 3.9 3.10 3.11 3.12 Capital Expenditure Model Assumptions

Tables 3.11 3.12 shows that Co-Incident non-coincident demand

TABLE 3.2: circle wise growth rates considered for each consumer category

	Vijaya wada	Guntur	Ongole	Nellore	Tiru pati	Kadapa	Anan tapur	Kurn ool	APS PDCL
<b>LT Category</b>									
LT-I Domestic	12.30%	12.60%	8.90%	9.20%	9.80%	9.70%	10.60%	10.90%	10.90%
LT-II Non-domestic/ Commercial	10.20%	11.30%	7.10%	8.30%	7.60%	8.00%	9.30%	8.10%	9.20%
LT-III Industrial	22.50%	8.00%	10.50%	20.50%	6.20%	2.10%	3.00%	2.00%	15.60%
LT-IV Cottage Industries	3.30%	6.20%	10.20%	2.00%	5.00%	2.00%	13.00%	3.50%	7.90%
LT-V Agriculture	2.00%	2.00%	5.20%	3.50%	7.40%	3.00%	3.20%	3.20%	4.10%
LT-VI Street Lighting & PWS	3.50%	2.10%	2.00%	2.00%	5.00%	7.00%	1.90%	5.90%	4.20%
LT-VII General Purpose	7.60%	7.90%	9.20%	5.00%	7.30%	7.80%	6.30%	7.90%	7.40%
LT-VIII Temporary Supply	10.00%	15.90%	2.00%	2.00%	28.80%	10.00%	2.00%	26.10%	20.50%
<b>HT Category at 11 KV</b>									
HT-I Industry Segregated	5.40%	15.20%	12.00%	12.10%	8.20%	14.20%	12.00%	8.60%	10.70%
Lights & Fans	5.40%	15.20%	12.00%	12.10%	8.20%	14.20%	12.00%	8.60%	14.10%
Colony consumption	5.40%	15.20%	12.00%	12.10%	8.20%	14.20%	12.00%	8.60%	13.60%
Seasonal Industries	2.00%	2.00%	2.00%	-	2.00%	10.00%	-	10.00%	4.70%
HT-I (B) Ferro-Alloys	3.00%	-	2.00%	-	-	-	-	-	2.00%
HT-II Others (Commercial)	11.70%	9.90%	15.00%	5.00%	2.00%	4.50%	8.90%	3.00%	8.30%
HT-III Airports, Bus Stations and Railway Stations	5.00%	5.00%	6.00%	2.00%	12.00%	3.00%	3.60%	4.20%	6.40%
HT-IV(A) Govt. Lift Irrigation Schemes	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
HT-IV(B) Agriculture	-	-	-	-	-	-	-	-	-
HT-IV(C) CPWS	2.00%	-	2.00%	2.00%	-	2.00%	2.00%	2.00%	2.00%
HT-VI Townships and Residential Colonies	12.00%	12.00%	2.00%	5.40%	2.00%	2.00%	2.00%	2.00%	6.90%
RESCOs	-	-	-	-	9.10%	-	-	-	9.10%
HT-VIII Temporary Supply	-	-	-	-	-	-	-	2.00%	2.00%
<b>HT Category at 33 KV</b>									
HT-I Industry Segregated	7.40%	2.00%	2.00%	2.00%	3.40%	2.00%	2.00%	10.00%	3.40%
Lights & Fans	6.60%	2.00%	2.00%	2.00%	3.40%	2.00%	2.00%	10.00%	3.80%
Colony consumption	2.70%	2.00%	2.00%	2.00%	3.40%	2.20%	2.00%	-	2.20%
Seasonal Industries	5.00%	2.00%	2.00%	-	-	-	-	-	2.50%
HT-I (B) Ferro-Alloys	-	-	2.00%	2.00%	-	10.00%	5.00%	-	5.30%
HT-II Others (Commercial)	16.10%	24.40%	2.00%	2.00%	16.00%	10.00%	10.00%	8.00%	15.40%
HT-III Airports, Bus Stations and Railway Stations	5.00%	-	-	-	5.00%	-	-	-	5.00%
HT-IV(A) Govt. Lift Irrigation Schemes	2.00%	2.00%	2.00%	-	-	-	-	2.00%	1.90%
HT-IV(C) CPWS	-	-	-	-	-	2.00%	2.00%	-	2.00%
HT-VI Townships and Residential Colonies	12.00%	12.00%	-	8.80%	-	-	2.00%	-	11.20%
<b>Category</b>									
<b>LT Category</b>									
LT-I Domestic	12.30%	12.60%	8.90%	9.20%	9.80%	9.70%	10.60%	10.90%	10.90%
LT-II Non-domestic/ Commercial	10.20%	11.30%	7.10%	8.30%	7.60%	8.00%	9.30%	8.10%	9.20%
LT-III Industrial	22.50%	8.00%	10.50%	20.50%	6.20%	2.10%	3.00%	2.00%	15.60%
LT-IV Cottage Industries	3.30%	6.20%	10.20%	2.00%	5.00%	2.00%	13.00%	3.50%	7.90%
LT-V Agriculture	2.00%	2.00%	5.20%	3.50%	7.40%	3.00%	3.20%	3.20%	4.10%
LT-VI Street Lighting & PWS	3.50%	2.10%	2.00%	2.00%	5.00%	7.00%	1.90%	5.90%	4.20%
LT-VII General Purpose	7.60%	7.90%	9.20%	5.00%	7.30%	7.80%	6.30%	7.90%	7.40%
LT-VIII Temporary Supply	10.00%	15.90%	2.00%	2.00%	28.80%	10.00%	2.00%	26.10%	20.50%
<b>HT Category at 11 KV</b>									
HT-I Industry Segregated	5.40%	15.20%	12.00%	12.10%	8.20%	14.20%	12.00%	8.60%	10.70%
Lights & Fans	5.40%	15.20%	12.00%	12.10%	8.20%	14.20%	12.00%	8.60%	14.10%
Colony consumption	5.40%	15.20%	12.00%	12.10%	8.20%	14.20%	12.00%	8.60%	13.60%
Seasonal Industries	2.00%	2.00%	2.00%	-	2.00%	10.00%	-	10.00%	4.70%
HT-I (B) Ferro-Alloys	3.00%	-	2.00%	-	-	-	-	-	2.00%
HT-II Others (Commercial)	11.70%	9.90%	15.00%	5.00%	2.00%	4.50%	8.90%	3.00%	8.30%
HT-III Airports, Bus Stations and Railway Stations	5.00%	5.00%	6.00%	2.00%	12.00%	3.00%	3.60%	4.20%	6.40%
HT-IV(A) Govt. Lift Irrigation Schemes	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
HT-IV(B) Agriculture	-	-	-	-	-	-	-	-	-
HT-IV(C) CPWS	2.00%	-	2.00%	2.00%	-	2.00%	2.00%	2.00%	2.00%
HT-VI Townships and Residential Colonies	12.00%	12.00%	2.00%	5.40%	2.00%	2.00%	2.00%	2.00%	6.90%
RESCOs	-	-	-	-	9.10%	-	-	-	9.10%
HT-VIII Temporary Supply	-	-	-	-	-	-	-	2.00%	2.00%
<b>HT Category at 33 KV</b>									
HT-I Industry Segregated	7.40%	2.00%	2.00%	2.00%	3.40%	2.00%	2.00%	10.00%	3.40%
Lights & Fans	6.60%	2.00%	2.00%	2.00%	3.40%	2.00%	2.00%	10.00%	3.80%
Colony consumption	2.70%	2.00%	2.00%	2.00%	3.40%	2.20%	2.00%	-	2.20%
Seasonal Industries	5.00%	2.00%	2.00%	-	-	-	-	-	2.50%
HT-I (B) Ferro-Alloys	-	-	2.00%	2.00%	-	10.00%	5.00%	-	5.30%
HT-II Others (Commercial)	16.10%	24.40%	2.00%	2.00%	16.00%	10.00%	10.00%	8.00%	15.40%
HT-III Airports, Bus Stations and Railway Stations	5.00%	-	-	-	5.00%	-	-	-	5.00%
HT-IV(A) Govt. Lift Irrigation Schemes	2.00%	2.00%	2.00%	-	-	-	-	2.00%	1.90%
HT-IV(C) CPWS	-	-	-	-	-	2.00%	2.00%	-	2.00%
HT-VI Townships and Residential Colonies	12.00%	12.00%	-	8.80%	-	-	2.00%	-	11.20%

HT Category at 132 KV									
HT-I Industry Segregated	3.00%	5.20%	2.00%	2.00%	13.30%	2.00%	2.00%	2.00%	-11.15%
Lights & Fans	3.00%	5.20%	2.00%	-	13.30%	2.00%	2.00%	2.00%	163.54%
Colony consumption	3.00%	5.20%	2.00%	-	-	2.00%	2.00%	2.00%	9.86%
Seasonal Industries	-	-	-	-	-	-	-	-	-
HT-I (B) Ferro-Alloys	-	-	-	-	1.20%	-	-	10.00%	35.61%
HT-II Others (Commercial)	-	-	-	18.90%	-	2.00%	-	-	31.70%
HT-IV(A) Govt. Lift	-	-	-	-	-	-	5.00%	2.00%	9.76%
Irrigation Schemes	-	-	-	-	-	-	-	-	-
HT-V Railway Traction	5.00%	5.00%	5.60%	5.00%	5.00%	5.00%	10.00%	10.00%	13.84%

TABLE 3.3: Sales projections for 4th Control Period

	FY 18 (Actual)	FY 19 (Approved)	FY20	FY21	FY22	FY23	FY24	CAGR
LT-I Domestic	8,167	9,168	10,044	11,141	12,360	13,715	15,221	10.90%
LT-II Non-domestic/Commercial	1,750	1,906	2,084	2,275	2,484	2,712	2,962	9.20%
LT-III Industrial	2,038	2,303	2,668	3,072	3,552	4,122	4,802	15.40%
LT-IV Cottage Industries	40	43	47	50	54	59	63	7.80%
LT-V Agriculture	8,640	8,742	9,350	9,730	10,130	10,549	10,989	4.10%
LT-VI Street Lighting & PWS	700	771	758	790	823	857	893	4.20%
LT-VII General Purpose	101	109	117	125	135	145	155	7.40%
LT-VIII Temporary Supply	1.3	1.6	1.8	2.1	2.6	3.1	3.8	20.10%
<b>LT Total</b>	<b>21,438</b>	<b>23,044</b>	<b>25,069</b>	<b>27,186</b>	<b>29,539</b>	<b>32,162</b>	<b>35,089</b>	<b>8.60%</b>
<b>HT Category</b>								
HT-I Industry	6,455	7,021	7,192	7,612	8,072	8,576	9,130	5.90%
HT-I (B) Ferro-Alloys	398	416	436	458	480	505	531	4.90%
HT-II Others (Commercial)	774	803	929	1,022	1,127	1,247	1,384	10.20%
HT-III Public Infrastructure and Tourism	56	59	63	67	71	75	80	6.10%
HT-IV Agriculture	1,079	2,436	1,128	1,154	1,180	1,207	1,235	2.30%
HT-V Railway Traction	740	722	823	868	915	966	1,019	5.50%
HT-VI Townships and Residential Colonies	26	37	30	32	34	37	40	7.30%
HT-VII Green Power	0	0	0	0	0	0	0	0.00%
HT-VIII RESCOs	369	385	438	478	521	569	620	9.10%
HT-VIII Temporary Supply	0.48	0.12	0.5	0.51	0.52	0.53	0.54	2.00%
<b>HT Total</b>	<b>9,897</b>	<b>11,878</b>	<b>11,039</b>	<b>11,690</b>	<b>12,402</b>	<b>13,182</b>	<b>14,039</b>	<b>6.00%</b>
<b>LT+HT Total</b>	<b>31,335</b>	<b>34,922</b>	<b>36,109</b>	<b>38,876</b>	<b>41,941</b>	<b>45,344</b>	<b>49,128</b>	<b>7.80%</b>



TABLE 3.4: APSPDCL Sales projections (Grossed up with losses) for 4th Control Period

	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23	FY 2023-24
<b>Annual LT Loss %</b>	4.40%	4.31%	4.23%	4.14%	4.06%	3.98%
<b>Energy Requirement at LT level (MU)</b>	24,129	26,223	28,409	30,840	33,546	36,567
<b>Annual 11 KV Loss %</b>	3.38%	3.31%	3.25%	3.18%	3.12%	3.06%
<b>Energy Requirement at 11KV level (MU)</b>	28,262	30,542	33,103	35,949	39,115	42,646
<b>Annual 33 KV Loss %</b>	3.35%	3.28%	3.22%	3.15%	3.09%	3.03%
<b>Energy Requirement at 33 KV level (MU)</b>	32,718	35,308	38,080	41,153	44,567	48,367
<b>Total Energy Requirement at 33 KV + 132 KV Sales</b>	<b>38,058</b>	<b>39,433</b>	<b>42,399</b>	<b>45,682</b>	<b>49,324</b>	<b>53,373</b>

TABLE 3.5: co-incident load factors for all circles in APSPDCL

Circle Name	Coincident load factor
Vijayawada	82.5%
Guntur	85.7%
Ongole	63.2%
Nellore	68.6%
Tirupati	60.1%
Kadapa	49.6%
Anantapur	55.8%
Kurnool	60.4%
<b>Total DISCOM</b>	<b>68.5%</b>

TABLE 3.6: Co-incident peak demand required for 4th Control Period

Circle Name	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23	FY 2023-24
<b>Circle 1: Vijayawada</b>	754	838	926	1,026	1,139	1,269
<b>Circle 2: Guntur</b>	737	781	846	919	1,000	1,090
<b>Circle 3: Ongole</b>	636	666	713	764	819	879
<b>Circle 4: Nellore</b>	732	796	867	947	1,038	1,143
<b>Circle 5: Tirupati</b>	1,066	1,177	1,270	1,371	1,481	1,601
<b>Circle 6: Kadapa</b>	814	831	873	919	968	1,021
<b>Circle 7: Anantapur</b>	1,010	1,023	1,076	1,132	1,192	1,258
<b>Circle 8: Kurnool</b>	958	800	844	890	941	995
<b>Total DISCOM</b>	<b>6,346</b>	<b>6,575</b>	<b>7,070</b>	<b>7,617</b>	<b>8,225</b>	<b>8,900</b>

TABLE 3.7: Capital Expenditure Model Assumptions: part 1

Particulars	Unit	Value
PTR Capacity/ SS	MVA	5
DTR Capacity/ SS	KVA	100
Number of PTRs/SS	Nos.	1

TABLE 3.8: Capital Expenditure Model Assumptions: part 2

Diversity Factor	
DTR	4
PTR	2.5

TABLE 3.9: Capital Expenditure Model Assumptions: part 3

Average Lengths (As on 31 <sup>st</sup> March 2018)	LT	11kV	33 kV
	Km per 100 KVA DTR	Km per 100 KVA DTR	Km per 5 MVA PTR
Vijayawada	0.62	0.24	7.11
Guntur	0.38	0.28	6.81
Ongole	0.58	0.53	9.35
Nellore	0.34	0.21	7.97
Tirupati	0.25	0.21	6.00
Kadapa	0.19	0.20	5.64
Anantapur	0.36	0.26	8.07
Kurnool	0.38	0.26	9.34

TABLE 3.10: Capital Expenditure Model Assumptions: part 4

Capital Cost	Value	Units
LT Line	2.85	Rs. Lakhs/Km
DTR per Unit (100 kVA)	2.5	Rs. Lakhs/Unit
11 kV Line	3.08	Rs. Lakhs/Km
33/11kV SS per Unit (5 MVA)	130.91	Rs. Lakhs/Unit
33 kV Line	4.62	Rs. Lakhs/Km
<b>Cost Escalation Rate - 5% per year</b>		

TABLE 3.11: Co-Incident non-coincident demand: part 1

Co-Incident Demand (MW)											
Circle Name	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29
Vijayawada	754	816	890	973	1,067	1,174	1,295	1,434	1,593	1,776	1,987
Guntur	737	762	814	870	932	1,000	1,074	1,154	1,243	1,340	1,446
Ongole	636	666	713	764	819	879	945	1,016	1,093	1,178	1,269
Nellore	732	796	867	947	1,038	1,143	1,263	1,401	1,560	1,744	1,958
Tirupati	1,066	1,177	1,270	1,371	1,481	1,601	1,732	1,874	2,030	2,200	2,386
Kadapa	814	831	873	919	968	1,021	1,079	1,140	1,207	1,279	1,357
Anantapur	1,010	1,023	1,076	1,132	1,192	1,258	1,328	1,404	1,486	1,575	1,671
Kurnool	958	800	844	890	941	995	1,054	1,119	1,188	1,264	1,347
<b>Total DISCOM</b>	<b>6,346</b>	<b>6,525</b>	<b>6,986</b>	<b>7,494</b>	<b>8,053</b>	<b>8,671</b>	<b>9,356</b>	<b>10,116</b>	<b>10,963</b>	<b>11,909</b>	<b>12,967</b>

TABLE 3.12: Co-Incident non-coincident demand: part 2

Non Co-Incident Demand (MW)											
Circle Name	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29
Vijayawada	1,008	1,091	1,190	1,301	1,426	1,569	1,731	1,916	2,129	2,374	2,657
Guntur	828	856	914	978	1,048	1,123	1,206	1,297	1,396	1,505	1,625
Ongole	699	732	783	840	900	966	1,038	1,116	1,201	1,294	1,395
Nellore	740	804	876	957	1,049	1,155	1,276	1,416	1,577	1,763	1,979
Tirupati	1,264	1,396	1,506	1,626	1,756	1,899	2,054	2,223	2,408	2,610	2,830
Kadapa	879	898	944	993	1,046	1,103	1,165	1,232	1,304	1,382	1,466
Anantapur	1,134	1,149	1,208	1,271	1,339	1,413	1,492	1,577	1,669	1,769	1,877
Kurnool	982	821	865	913	964	1,020	1,081	1,147	1,218	1,296	1,381
<b>Total DISCOM</b>	<b>6,346</b>	<b>6,525</b>	<b>6,986</b>	<b>7,494</b>	<b>8,053</b>	<b>8,671</b>	<b>9,356</b>	<b>10,116</b>	<b>10,963</b>	<b>11,909</b>	<b>12,967</b>

## Chapter 4

# FINDINGS AND ANALYSIS

### 4.1 Projection of Capital Expenditure for the 4th control period:

The MVA capacity thus arrived is used to estimate the number of DTRs and PTRs. It is assumed that each DTR substation will be of 100 KVA and each PTR will be of 5 MVA. It is also assumed that every 33/11 KV SS will have only one 5 MVA PTR.

Table 4.1 shows the number of 100 KVA DTRs required and number of 5 MVA 33/11 KV SS required in 4th Control Period in each circle.

### 4.2 Circle wise DTRs and PTRs requirement analysis:

Table 4.2 shows the number of 100 KVA DTRs required and number of 5 MVA 33/11 KV SS required in 5th Control Period.

TABLE 4.1: Number of 100 KVA DTRs required and number of 5 MVA 33/11 KV SS required in 4th Control Period in each circle

	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23	FY 2023-24
<b>Vijayawada</b>						
No of 100 KVA DTRs	2540.0	3490.0	3690.0	4230.0	4870.0	5620.0
No of 5 MVA 33/11 KV SS	39.0	47.0	52.0	59.0	68.0	78.0
<b>Guntur</b>						
No of 100 KVA DTRs	2200.0	1330.0	2080.0	2320.0	2590.0	2890.0
No of 5 MVA 33/11 KV SS	35.0	19.0	32.0	36.0	40.0	45.0
<b>Ongole</b>						
No of 100 KVA DTRs	1610.0	1170.0	1560.0	1690.0	1830.0	1980.0
No of 5 MVA 33/11 KV SS	27.0	15.0	24.0	26.0	28.0	31.0
<b>Nellore</b>						
No of 100 KVA DTRs	1610.0	2050.0	2220.0	2550.0	2930.0	3370.0
No of 5 MVA 33/11 KV SS	25.0	28.0	32.0	37.0	42.0	48.0
<b>Tirupati</b>						
No of 100 KVA DTRs	1090.0	3740.0	2720.0	2940.0	3180.0	3440.0
No of 5 MVA 33/11 KV SS	24.0	53.0	43.0	47.0	51.0	55.0
<b>Kadapa</b>						
No of 100 KVA DTRs	950.0	1670.0	1460.0	1560.0	1680.0	1810.0
No of 5 MVA 33/11 KV SS	14.0	22.0	20.0	22.0	24.0	26.0
<b>Anantapur</b>						
No of 100 KVA DTRs	1230.0	1930.0	1760.0	1890.0	2040.0	2200.0
No of 5 MVA 33/11 KV SS	20.0	24.0	25.0	27.0	29.0	31.0
<b>Kurnool</b>						
No of 100 KVA DTRs	1180.0	1210.0	1350.0	1470.0	1600.0	1750.0
No of 5 MVA 33/11 KV SS	16.0	17.0	18.0	20.0	22.0	24.0

The additional length required for each LT, 11 KV and 33 KV voltage lines for installations of the new DTRs and PTRs is estimated using the below ratios which are calculated at baseline date 31st Mar 2018.

- Lengths of LT line (in KM) per 100 KVA DTR
- Lengths of 11 KV line (in KM) per 100 KVA DTR

– Lengths of 33 KV line (in KM) per 5 MVA PTR

Table 4.3 shows the lengths of LT, 11 KV and 33 KV lines arrived at all circle wises as on 31st Mar 2018.

These ratios are assumed to remain same or reduce for 4th and 5th control periods in order to ensure adequate capital invested.

Table 4.4 shows the additional LT, 11 KV and 33 KV lines required (in KMs) for all the years in 4th control period.

The capital expenditure required to install 100 KVA DTRs, 5 MVA 33/11 KVA SS, LT lines, 11 KV lines and 33 KV lines is calculated by assuming existing per unit cost numbers.

The cost data for FY 2015-16 is considered for arriving at the capital expenditure for all the years with cost escalation of 2

### 4.3 Standard Cost items:

Table 4.5 shows the rates assumed and used to forecast the capital expenditure for installations of PTRs and DTRs.

Above table shows the summary of forecast of the capital expenditure required for additional loads at each LT, 11 KV and 33 KV voltage levels.

The LT expenditure forecast will involve expenditure on LT lines required. The 11 KV expenditure forecast will involve expenditure on 11 KV lines and expenditure on 100 KVA DTRs required. The 33 KV expenditure forecast will involve expenditure on 33 KV lines and expenditure on 5 MVA PTRs required.

TABLE 4.2: the number of 100 KVA DTRs required and number of 5 MVA 33/11 KV SS required in 5th Control Period

	FY 2024-25	FY 2025-26	FY 2026-27	FY 2027-28	FY 2028-29
<b>Vijayawada</b>					
No of 100 KVA DTRs	6490.0	7520.0	8720.0	10150.0	11840.0
No of 5 MVA 33/11 KV SS	89.0	103.0	119.0	138.0	161.0
<b>Guntur</b>					
No of 100 KVA DTRs	3230.0	3610.0	4030.0	4510.0	5040.0
No of 5 MVA 33/11 KV SS	50.0	56.0	63.0	71.0	80.0
<b>Ongole</b>					
No of 100 KVA DTRs	2140.0	2320.0	2510.0	2730.0	2960.0
No of 5 MVA 33/11 KV SS	34.0	37.0	40.0	44.0	48.0
<b>Nellore</b>					
No of 100 KVA DTRs	3900.0	4520.0	5260.0	6130.0	7160.0
No of 5 MVA 33/11 KV SS	55.0	64.0	74.0	86.0	100.0
<b>Tirupati</b>					
No of 100 KVA DTRs	3730.0	4030.0	4370.0	4730.0	5130.0
No of 5 MVA 33/11 KV SS	59.0	64.0	70.0	75.0	82.0
<b>Kadapa</b>					
No of 100 KVA DTRs	1950.0	2100.0	2260.0	2440.0	2640.0
No of 5 MVA 33/11 KV SS	28.0	30.0	32.0	35.0	38.0
<b>Anantapur</b>					
No of 100 KVA DTRs	2370.0	2570.0	2780.0	3010.0	3260.0
No of 5 MVA 33/11 KV SS	34.0	37.0	40.0	43.0	47.0
<b>Kurnool</b>					
No of 100 KVA DTRs	1910.0	2080.0	2270.0	2480.0	2720.0
No of 5 MVA 33/11 KV SS	26.0	28.0	31.0	34.0	37.0



TABLE 4.3: The lengths of LT, 11 KV and 33 KV lines arrived at all circle wise as on 31st Mar 2018

Average Lengths as on 31st March 2018	LT	11KV	33 KV
	Km per 100 KVA DTR	Km per 100 KVA DTR	Km per 5 MVA PTR
Vijayawada	0.62	0.24	7.11
Guntur	0.38	0.28	6.81
Ongole	0.58	0.53	9.35
Nellore	0.34	0.21	7.97
Tirupati	0.25	0.21	6.00
Kadapa	0.19	0.20	5.64
Anantapur	0.36	0.26	8.07
Kurnool	0.38	0.26	9.34

TABLE 4.4: The additional LT, 11 KV and 33 KV lines required (in KMs) for all the years in 4th control period

	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23	FY 2023-24
<b>LT</b>	1,577	2,167	2,291	2,626	3,024	3,490
<b>11KV</b>	615	846	894	1,025	1,180	1,362
<b>33 KV</b>	277	334	370	419	483	554
<b>Guntur</b>						
<b>LT</b>	843	509	797	889	992	1,107
<b>11KV</b>	625	378	591	659	735	821
<b>33 KV</b>	238	129	218	245	272	306
<b>Ongole</b>						
<b>LT</b>	1,281	774	1,211	1,350	1,508	1,682
<b>11KV</b>	1,162	702	1,098	1,225	1,368	1,526
<b>33 KV</b>	327	178	299	337	374	421
<b>Nellore</b>						
<b>LT</b>	552	401	535	579	627	678
<b>11KV</b>	338	246	328	355	385	416
<b>33 KV</b>	215	120	191	207	223	247
<b>Tirupati</b>						
<b>LT</b>	395	503	545	626	719	827
<b>11KV</b>	339	432	467	537	617	710
<b>33 KV</b>	150	168	192	222	252	288
<b>Kadapa</b>						
<b>LT</b>	185	325	284	304	327	353
<b>11KV</b>	191	336	294	314	338	364
<b>33 KV</b>	79	124	113	124	135	147
<b>Anantapur</b>						
<b>LT</b>	445	699	637	684	738	796
<b>11KV</b>	320	502	458	492	531	573
<b>33 KV</b>	161	194	202	218	234	250
<b>Kurnool</b>						
<b>LT</b>	445	456	509	554	603	660
<b>11KV</b>	305	313	349	381	414	453
<b>33 KV</b>	149	159	168	187	205	224

TABLE 4.5: the rates assumed and used to forecast the capital expenditure for installations of PTRs and DTRs

Capital Expenditure	Value	Units
LT Line	2.85	Rs. Lakhs/Km
DTR per Unit (100 KVA)	2.5	Rs. Lakhs/Unit
11 KV Line	3.08	Rs. Lakhs/Km
33/11KV SS per Unit (5 MVA)	130.91	Rs. Lakhs/Unit
33 KV Line	4.62	Rs. Lakhs/Km

## Chapter 5

# INTERPRETATION OF RESULTS

### 5.1 Capital Expenditure(in Cr) in additional infrastructure in 4th Control period

Tables 5.1 and 5.2 shows the capital expenditure for 4<sup>th</sup> control period in additional infrastructure

### 5.2 Total capital expenditure required through licensee spend

Other than additional infrastructure, licensee expects to spend some amount on activities such as System improvements and TD works, Renovation Modernization, Technology Upgradation, Civil Infrastructure Development and on metering and associated equipment.

Table 5.3 is the total spend expected under licensee spend in 4th control period.

	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23	FY 2023-24
<b>Vijayawada</b>						
<b>LT</b>	46	64	69	81	95	112
<b>11KV</b>	84	118	127	149	175	205
<b>33 KV</b>	65	80	90	105	123	144
<b>Guntur</b>						
<b>LT</b>	24	15	24	27	31	36
<b>11KV</b>	76	47	74	85	96	110
<b>33 KV</b>	58	32	55	63	72	82
<b>Ongole</b>						
<b>LT</b>	37	23	37	42	47	54
<b>11KV</b>	93	57	91	104	118	134
<b>33 KV</b>	62	34	58	67	75	86
<b>Nellore</b>						
<b>LT</b>	16	12	16	18	20	22
<b>11KV</b>	52	38	52	58	64	70
<b>33 KV</b>	46	26	43	47	52	59
<b>Tirupati</b>						
<b>LT</b>	11	15	16	19	23	27
<b>11KV</b>	52	67	74	87	102	119
<b>33 KV</b>	40	46	54	64	74	86
<b>Kadapa</b>						
<b>LT</b>	5	10	9	9	10	11
<b>11KV</b>	30	54	48	52	57	62
<b>33 KV</b>	22	36	33	37	41	45
<b>Anantapur</b>						
<b>LT</b>	13	21	19	21	23	26
<b>11KV</b>	41	66	62	68	74	82
<b>33 KV</b>	34	42	45	49	54	59
<b>Kurnool</b>						
<b>LT</b>	13	14	15	17	19	21
<b>11KV</b>	40	42	47	52	58	65
<b>33 KV</b>	28	31	33	38	42	47
<b>Total</b>	<b>990</b>	<b>989</b>	<b>1,193</b>	<b>1,357</b>	<b>1,545</b>	<b>1,763</b>

TABLE 5.1: Caption

### 5.3 Capital expenditure required under sponsored schemes

Many of the system and infrastructure improvement activities are carried out in LI-CENSEE under various schemes such as IPDS, DDUGJY, HVDS, System Improvement scheme etc. World bank and other agencies sponsors few activities in the discom.

Capex Headers	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23	FY 2023-24	FY 2024-25	FY 2025-26	FY 2026-27	FY 2027-28	FY 2028-29
Capex towards Substations	267	306	342	388	439	498	564	643	734	839	965
Capex towards DTRs	316	432	447	505	572	649	739	842	962	1,103	1,267
Capex towards Lines	407	251	404	464	533	616	710	822	950	1,106	1,285

TABLE 5.2: Caption

Sr. No.	Item	FY19	FY20	FY21	FY22	FY23	FY24
1	SS Additions (Indoor)	83.9	73.5	72.3	90.6	70.2	81.6
2	SS Additions (Outdoor)	191.1	199.6	226.6	262.7	304.1	353.5
3	PTR Additions	43.6	43.5	52.3	60.6	70.2	81.6
4	Lines, Cables & Network including Extension of Service to New Consumers /Additional Loads	537.1	273.2	408.1	447.1	477.0	559.0
5	DTR Additions	816.7	883.0	616.0	631.9	601.8	698.5
6	Metering & Associated equipment	30.8	20.0	20.0	20.0	20.0	20.0
7	Switchgear (VCBs, Isolators and associated equipment)	15.7	15.5	17.4	20.2	23.4	27.2
8	AT&C Loss Reduction measures	79.5	118.2	118.2	80.2	-	-
9	System Improvements and T&D Works	145.0	270.3	215.8	121.6	127.6	134.0
10	Renovation & Modernization	17.0	25.0	25.0	17.0	26.3	27.6
11	Technology Upgradation	58.7	15.0	15.0	10.0	50.0	50.0
12	Civil Infrastructure Development	15.0	15.8	16.5	17.4	18.2	19.1
13	Smart Metering , IT & ERP	72.0	62.0	62.0	40.0	-	-
14	SCADA/DMS in Viayawada, Guntur & Nellore	46.0	69.0	69.0	46.0	-	-
<b>Total (Rs. Cr.)</b>		<b>2,152.2</b>	<b>2,083.5</b>	<b>1,934.2</b>	<b>1,865.2</b>	<b>1,788.7</b>	<b>2,052.1</b>

TABLE 5.3: Caption

Table 5.4 shows the projected capital expenditure in APSPDCL under various schemes and various grants in 4th and 5th Control Period.

Sr. No.	Item	FY19	FY20	FY21	FY22	FY23	FY24
1	SS Additions (Indoor)	40	46	51	58	66	75
2	SS Additions (Outdoor)	174	199	222	252	286	324
3	PTR Additions	40	46	51	58	66	75
4	Lines, Cables & Network including Extension of Service to New Consumers /Additional Loads	407	251	404	464	533	616
5	DTR Additions	316	432	447	505	572	649
6	Metering & Associated equipment	20	20	20	20	20	20
7	Switchgear (VCBs, Isolators and associated equipment)	13	15	17	19	22	25
8	System Improvements and T&D Works	105	110	116	122	128	134
9	Renovation & Modernization	-	-	-	-	26	28
10	Technology Upgradation	-	-	-	-	50	50
11	Civil Infrastructure Development	15	16	17	17	18	19
<b>Total (Rs. Cr.)</b>		<b>1,130</b>	<b>1,135</b>	<b>1,345</b>	<b>1,516</b>	<b>1,787</b>	<b>2,014</b>

TABLE 5.4: Caption

## 5.4 Total capital expenditure required under schemes and under licensee spend

Table 5.5 shows the summary of the total capital expenditure projected under various schemes and under licensee spend in 4th Control period.

Sr. No.	Item	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29
Actuals							Projections - 4 <sup>th</sup> Control Period						Projections - 5 <sup>th</sup> Control Period				
1	HVDS	366	465	312	367	763	590	652	337	228	-	-	-	-	-	-	-
2	Agri (New Consumer)	8	196	268	319	196	206	216	227	239	251	263	276	290	305	320	336
3	Solar	-	-	80	149	173	-	-	-	-	-	-	-	-	-	-	-
4	IPDS	-	-	9	125	178	89	2	2	-	-	-	-	-	-	-	-
5	DDUGJY	-	-	17	219	125	76	85	-	-	-	-	-	-	-	-	-
6	Other Grants	38	8	4	3	1	17	11	-	-	-	-	-	-	-	-	-
<b>Total (Rs. Cr.)</b>		<b>411</b>	<b>669</b>	<b>690</b>	<b>1,182</b>	<b>1,437</b>	<b>978</b>	<b>967</b>	<b>566</b>	<b>467</b>	<b>251</b>	<b>263</b>	<b>276</b>	<b>290</b>	<b>305</b>	<b>320</b>	<b>336</b>

TABLE 5.5: Caption

## Chapter 6

# CONCLUSIONS AND SCOPE FOR FUTURE WORK

Capital expenditure is one of the major expense in the Discom's aggregate revenue requirement (ARR) of distribution business of a Discom. The accurate estimation and projection of capital expenditure in distribution MYT will recover the near to exact RRB in arr. This project has given the information regarding the various cost components in the capital expenditure of a power distribution company. Information regarding the various important parameters is taken into consideration while analysing the capital expenditure of a Discom. This project has given the information regarding estimation and projection strategy while analysing the capital expenditure of a power distribution company. The result of this analysis will give insight to the power distribution company while planning the future business expansion and it will enforce effective strategies to optimize their expenses.

After arriving the capital expenditure for the particular year by considering the various cost components, we would be able to calculate gross fixed asset of the company based on the effective capitalization of respective expenditure. The effective capitalization gives the information to the management in terms of its optimality in mitigating the capitalization



of expenditure. The effective capitalization is one of the performance indicators for the Discom in assessing the effective functioning in terms of their expenditure incurring.

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