DAFFODIL INTERNATIONAL UNIVERSITY

THESIS PAPER

ON

"STUSY ON ELECTRICITY GENERATION COST DETERMINATION"

Supervisor

Dr. M. Shamsul Alam

Professor and Dean

Faculty of Engineering

Daffodil International University

Prepared By

Abdur Rahman

ID: 153-33-2911

Department of EEE

Daffodil International University

APPROVAL

This thesis titled "Study on Electricity Generation Cost Determination", submitted by Abdur Rahman to the Department of Electrical and Electronics Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. Electrical and Electronics Engineering and approved as to its style and contents. The presentation has been held on

BOARD OF EXAMINERS

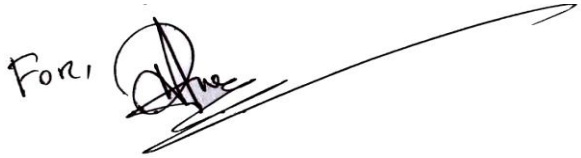
Professor Dr. M. Shamsul Alam

Dean

Faculty of Engineering

DECLARATION

We hereby declare that; this thesis has been done by us under the supervision of **Dr. M. Shamsul Alam Professor Dean** Faculty of Engineering Daffodil International University. We also declare that neither this thesis nor any part of this thesis has been submitted elsewhere for award of any degree or diploma.



Supervised by:

Professor Dr. M. Shamsul Alam

Dean

Faculty of Engineering

Daffodil International University

Submitted by:

Abdur Rahman

ID: 153-33-2911

Department of EEE

Daffodil International University

ACKNOWLEDGEMENT

First, we express our heartiest thanks and gratefulness to almighty Allah for his Divine blessing makes us possible to complete this thesis successfully.

We feel grateful to and wish our profound our indebtedness to Professor Dr. M. Shamsul Alam Dean Faculty of Engineering Daffodil International University, Dhaka. Deep knowledge& keen interest of our supervisor in the field of Electric power influenced us to carry out this thesis. His endless patience, scholarly guidance, continual encouragement, constantan energetic supervision, constructive criticism, valuable advice at all stage made it possible to complete this thesis. We would like to thank our entire course mate in Daffodil International University, who took part in this discuss while completing the course work. Finally, we must acknowledge with due respect the constant support and patients of our parents.

ABSTRACT

This thesis is on “Study on Electricity Generation Cost Determination”. In the solicited bids, the bidders shall offer bulk power tariff based on the capacity payment and energy payment and also provide the equivalent levelized tariff. The capacity payment will be made in Bangladeshi currency (Taka). This will cover debt service, return on equity, fixed operation and maintenance cost, insurance and other fixed cost. The energy payment will be denominated in local currency to the extent to which the variable costs are in local currency. This will cover the variable costs of operation and maintenance, including fuel. Interconnection of IPP to transmission system: The power will be purchased from the IPP at a specified voltage and frequency at the outgoing terminal of the substation of the power plant. The cost of interconnecting facilities up to outgoing terminals of the private power project will be borne by the private power producers. Severe power crisis compelled the Government to enter into contractual agreements for high cost temporary solution, such as rental power and small IPPs, on an emergency basis, much of its diesel or liquid-fuel based. This has imposed tremendous fiscal pressure. With a power sector which is almost dependent on natural-gas fired generation (89.22%), the country is confronting a simultaneous shortage of natural gas and electricity. Nearly 400-800 MW of power could not be availed from the power plants due to shortage of gas supply. Other fuels for generating low-cost, base-load energy, such as coal, or renewable source like hydropower, are not readily available and Government has no option but to go for fuel diversity option for power generation.

TABLE OF CONTENTS

TABLE OF CONTENTS

INDEX

CHAPTER 5: VARIABLE COST

CHAPTER 6: TARIFF CALCULATION

CHAPTER 7: CONCLUSION

CHART OF TABLES

CHAPTER 1

INTRODUCTION

1.1 Introduction

Electricity is the key of all modern inventions. Now-a-days it is a basic need of our everyday life. It plays a great role wherever people live and works in industry, agriculture, and transportation etc. The living customary and prosperity of a nation vary directly with increase in use of power. As technology is advancing the consumption of power is steady rising. Sufficient and reliable supply of electricity may be a major requirement for a sustained and triple-crown economic development effort and economic condition reduction. In Bangladesh 149.4 million of the populations out of 167 million don't have direct access to electricity and remaining 17.6 million folks have access however reliable and quality power remains on the far side their reach (BPDB, 2018). So as to realize the expansion rate, handiness of a fairly priced and reliable supply of electricity may be a requirement. Gift generation of electrical power in Bangladesh isn't sufficient to satisfy the customers growing demand. Therefore, it's uphill to make sure a relentless provides of electrical power to all or any customers throughout the country. On the opposite hand, the present power stations have lost their lifetime; they're not reliable for steady generation. Therefore, it's to get replaced previous generating units in varied power stations. Shortage of power is significant issue and robust barrier for the event of our country. Government of Bangladesh has such a large amount of limitations to line up sufficient powerhouse. The GOVT has given high priority to development of the arena considering its importance in overall development of the country. The GOVT has set the goal of providing electricity to all or any voters by 2020. [1] And to achieve this goal the government has already taken many steps. A lot of new power plants has been established.

Bangladesh's energy infrastructure is kind of tiny, inadequate and poorly managed. The per capita energy consumption in Bangladesh is one amongst very cheap (433 kWh) within the world. Non-commercial energy sources, equivalent to wood fuel, animal waste and crop residues square measure calculable to account for over 1/2 the country's energy consumption. Bangladesh has tiny reserves of oil and coal however terribly massive fossil fuel resources. Industrial energy consumption is usually fossil fuel (around 66%), followed by oil, hydropower and coal. Electricity is that the major supply of power for many of the country's economic activities. Bangladesh's put in electrical generation capability is 20000 MW in 2018 [2]; 90 percent of that is taken into account to be 'available'. 90 percent of the population has access to electricity with a per capita handiness of 433

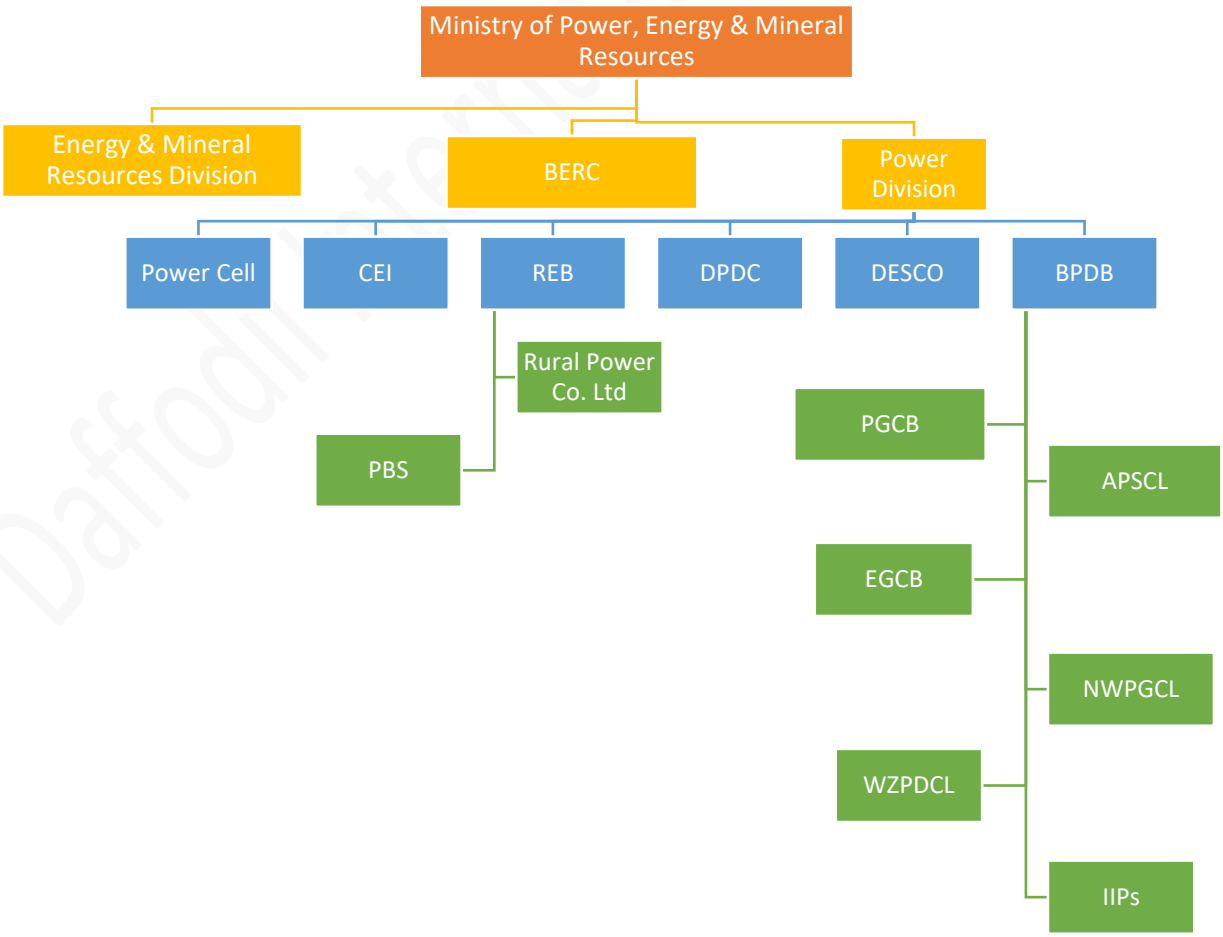
kWh every year. (29 0ctober, 2017)

Problems within the Bangladesh's electrical power sector embody corruption in administration, high system losses, and delays in completion of recent plants, low efficiencies, erratic power offer, electricity felony, blackouts and shortages of funds for power station maintenance. Overall, the country's generation plants are unable to satisfy system demand over the past decade. [3]

1.2 Electricity Generation Structure

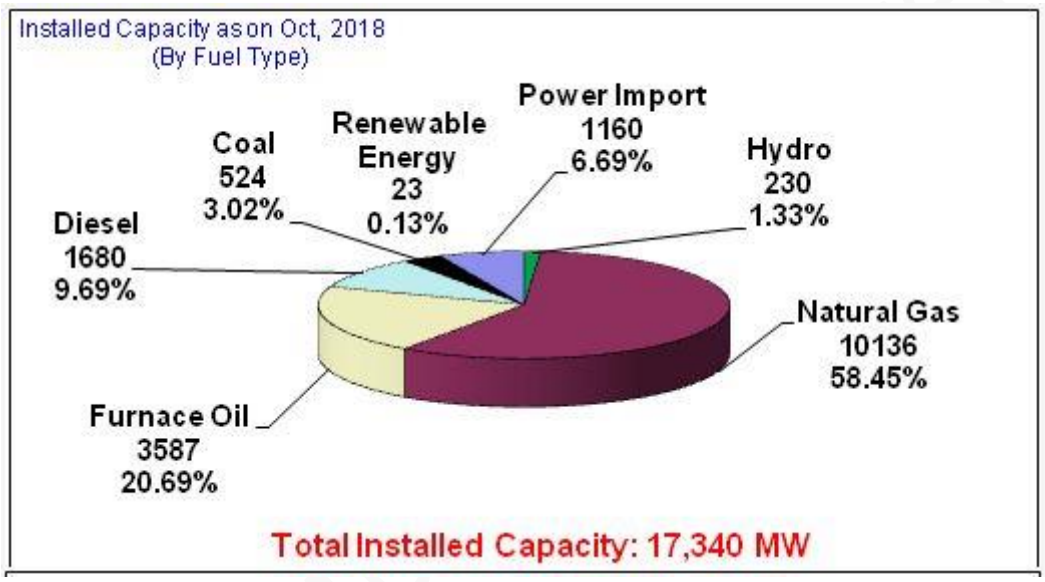
Under the Ministry of Power, Energy & Mineral Resources and Bangladesh Energy Regulatory Commission (BERC), government companies generate electricity with many different types of Power Plants. On the other hand, through IPP (Independent Power Producer) and through Rental electricity is produced in the private sector which is purchased by the Government at a fixed rate. Besides that, big industries produce 1200 MW electricity for their ow use from which additional 88 MW is supplied to the national grid. At present nearly, 63 percent of total electricity production is produced from public entities. BPDB alone produces 46 percent of total electricity production.

Electricity Generation Structure can be shown as:



1.3 Use of Different Types of Energy

Natural Gas is used as primary energy in most of the present power plants. 58.45% of total electricity is made from gas-based power plants. Besides gas, 9.69% of electricity is made by burning High Speed Diesel (HSD), 20.69% is made by burning Furnace Oil, 3.02% is made by burning coal, 0.13% comes from renewable energy and 6.69% is imported from India. Additionally, virtually the 1.33% of total electricity is made from Karnafuly Hydro power station. Because of the rise of multiple use of gas in chemical, industries, factories and alternative sectors it's unfeasible to produce adequate amount gas (extracted from the present gas fields) to fulfill the demand of the facility plants. Insufficiency of gas causes 500MW less production of electricity from existing power plants.



From the above discussion it is evident that in the power sector the following issues are to be addressed with due importance at the moment -

- Inadequacy of supply of electricity compared to demand.
- Dependency on single energy (gas) for electricity generation.
- Investment or participation of private sector in electricity generation is at the minimum level.
- To meet the increasing demand of electricity huge amount of investment is needed, the lion's share of which should come from private sector or from public- private partnership.
- Shortage of electricity is not attributed to generation alone but transmission and distribution are also responsible for the existing short fall.

- Limited use of renewable energy.

The Perspective arrange of the GOVT and also the Work arrange framed in per the angle arrange towards mitigation of the on top of mentioned issues square measure mentioned within the following chapters.

1.4 Power Sector in Outline Perspective Plan of Bangladesh

Following Vision for Power Sector Development has been mentioned in the Outline Perspective Plan of Bangladesh (2010-2021) –

- Electricity Generation in the country by 2010: 6500 MW
- Electricity Generation in the country by 2013: 8500 MW
- Electricity Generation in the country by 2015: 11,500 MW
- Electricity Generation in the country by 2018: 14000 MW
- Electricity Generation in the country by 2021: 20,000 MW
- Electricity for all by 2021

There is a planning of the Government of achieving the following objectives for making the vision a reality. The Following issues have been identified to reach the objectives –

- To ensure energy security.
- Making the power sector financially viable and able to facilitate economic growth.
- Increasing the sector's efficiency.
- Introducing a new corporate culture in the power sector entities.
- Improving the reliability and quality of electricity supply.
- Using natural gas including imported Liquefied Natural Gas (LNG), coal and oil as the primary fuels for electricity generation.
- Increasing private sector participation to mobilize finance.
- Matching supply and demand for electricity.

- To ensure energy security for all.
- To reduce the consumption of natural gas, thereby releasing gas for use as fertilizer, or to increase the use of coal for electricity production to release gas for alternative use.
- Finalization of the coal extraction plan.
- Reasonable cost-effective price policy for gas, coal and electricity, these being under government control.
- Energy mix for electricity generation.
- Energy conservation.
- Promotion of renewable.
- Efficiency of the power sector.
- Reduction of system loss.
- Importation of LNG.

To address these issues the following Constraints, Possibilities & Strategies are identified –

1.4.1 Constraints

- Insufficiency of fuel.
- Absence of adequate public and private investment in power generation.
- Absence of Cost Reflective Tariffs.
- Absence of Primary Energy Supply Chain.

1.4.2 Possibilities

- Coal-based power plants using domestic and imported coal.
- Rup-pur Nuclear Power Plant.
- Availability of new gas both Off-shore and On-shore.
- Public-Private Partnership Projects.
- Prospect of participation of local investors in the sector.
- Medium-term agreement to import LNG and steps to be taken.

1.4.3 Strategies

- To diversify the use of primary energy, such as - gas, coal and liquid fuel, for power generation.
- To have provision for dual fuel in power plants wherever possible.
- To increase power generation through renewable sources, such as solar, wind, small hydro etc.
- To implement nuclear fuel-based power plant.
- To finance power generation projects through Public-Private Partnership, government funding for Independent Power Producer (IPP).
- To increase sector efficiency, reform measures must be implemented. [4]

1.5 Objective

The Objective of this thesis study is to calculate the generating price of an electrical power station that's tariff calculation. The most objective is to be told concerning tariff and the way to calculate generating price of an electrical station. This thesis can facilitate to seek out the parameters that square measure caused to maximize the generating price. To do this, following terms need to be calculated one in every of them is that the fastened prices of generation, like Depreciation Expenses, Loan, Equity & regulative assets (RWC) and another one is Variable Costs that embody Fuel price and Non-Fuel price. Adding these 2 prices (Fixed Cost & Variable Costs) can result in the full generating price. Then it'll be simple to seek out the parameters that have an effect on the generating price largely and to reduce the generating price by taking necessary steps.

1.6 Thesis Outline

This thesis study is organized as follows –

Chapter-1 introduces the electricity generation structure, use of different types of energy, power sector in outline perspective plan of Bangladesh and the objective of this thesis study. Chapter-2 reviews the electricity generation tariff and electricity generation in Bangladesh. Chapter-3 discusses about the project cost of power plant and its categories.

Chapter-4 explains about the fixed cost of electricity generation along with its parameters. Chapter-5 describes about the variable cost and its parameters with few important terms.

Chapter-6 analyzes tariff calculation of electricity generation and presents the result.

Chapter-7 concludes with some recommendations, limitations and future scopes of the work.

CHAPTER 2

ELECTRICITY GENERATION TARIFF

2.1 Tariff

Tariff means that a document, approved by the Commission, listing the terms and conditions of service and a schedule of rates, beneath that licensee services are provided.

2.2 Electricity Tariff

Electricity tariff (sometimes cited as electricity evaluation or the value of electricity) varies widely from country to country, and should vary considerably from neck of the woods to neck of the woods among a particular country. There square measure several reasons that account for these variations in value. The price of power generation depends mostly on the kind and market value of the fuel used, government subsidies, government and business regulation, and even native weather patterns.

2.3 Basis of Electricity Rates

Electricity prices vary between countries and can even vary within a single region, or distribution network of the same country. In standard regulated monopoly markets, electricity rates typically vary for residential, commercial and industrial customers. Prices for any single class of electricity customer can also vary by time-of-day, or by the capacity, or nature of the supply circuit (e.g. 5 KW, 12 KW, 18 KW, 24 KW are typical in some of the large developed countries); for industrial customers, single-phase vs. 3-phase, etc. If a specific market allows real-time dynamic pricing, a more recent option in limited markets to date typically following the introduction of electronic metering, prices can even vary between times of low and high electricity network demand.
The actual electricity rate (Cost per unit of electricity) that a customer pays can often be heavily dependent on customer charges, particularly for small customers (e.g. residential users). [3]

2.4 Electricity Generation

Electricity generation is the process of generating electrical power from other sources of primary energy.

The fundamental principles of electricity generation were discovered during the 1820s and early 1830s by the British individual physicist. His basic technique continues to be used nowadays – 'Electricity is generated by the movement of a loop of wire, or disc of copper between the poles of a magnet.' For electrical utilities, it's the primary method within the delivery of electricity to shoppers. The opposite processes, electricity transmission, distribution and electric power storage and recovery mistreatment pumped-storage ways are commonly administrated by the electrical power trade. Electricity is most frequently generated at an influence station by electro-mechanical generators, primarily driven by heat engines fueled by chemical combustion, or fission however additionally by different means that cherish the K.E. of flowing water and wind. Different energy sources embrace star electrical phenomenon, geothermic power and electro-chemical battery. [5]

2.5 Electricity Generation in Bangladesh

There are some isolated diesel power stations at overseas and islands that don't seem to be connected with the National Grid. Terminal voltage of various generators is eleven potential units, 11KV, 11.5KV and 15.75 KV.

Different types of power plants generate electricity and synchronize it with the national grid. Within the Jap Zone (Eastern aspect of Jamuna river), electricity is generated from autochthonous gas and a little proportion through hydro power. Within the Western Zone, Coal and foreign liquid fuel is employed for generation of electricity. The fuel price per unit generation within the Western Zone is far above that of the Jap Zone. Therefore, as a policy, low price electricity generated within the Jap Zone is transferred to the Western Zone through the 230 potential unit East-West inhume instrumentation cable. [3]

2.6 Important Terms for Calculation

Availability Factor: It means the ratio of (a) the number of hours a generating unit is mechanically able to produce power in a given period to (b) the number of hours in the period. A

factor less than 100% indicates planned or unplanned outages for maintenance. A plant's availability factor will be higher than its capacity factor, because a plant is not used in every hour it is available.

Capacity Factor: It means the ratio of (a) the net amount of electricity a plant actually generates in a given time period to (b) the amount that the plant could have produced if it had operated continuously at full power operation during the same period. Capacity factor is dependent on both the mechanical availability of the plant and the economic desirability to run the plant given the particular cost to run it.

Commission: It means the Bangladesh Energy Regulatory Commission.

Effective Date: Means the date on which a proposed tariff schedule with rates is permitted by the Commission to become effective.

Independent Power Producer/Small Power Producer (IPP/SPP):

Independent Power Producer/Small Power Producer (IPP/SPP) is a non-government owned Generation Company. The Government of Bangladesh solicits selects and contracts with Independent Power Producers (IPP) and Small Power Producers (SPP) under the terms and conditions of its policies as published. Under the terms of the Bangladesh Energy Regulatory Commission (BERC) Act, all IPP/SPP are required to obtain a license from the BERC and have tariff rates charged-to-consumers approved by the BERC.

Kilowatt (KW): Means a measure of electricity defined as a unit of demand or capacity, measured as 1 kilowatt (1,000 watts) of power generated.

Kilowatt-Hour (KWh): It means a measure of electricity defined as a unit of work or energy, measured as 1 kilowatt (1,000 watts) of power expended for 1 hour.

Load Factor: Load Factor means the ratio of the average load to peak load served by a plant or power system during a specified time interval. A higher load factor indicates higher use of

the generating resources.

Rate: It means the authorized charges, per unit or level of consumption, for a specified time period for any of the classes of generation licensee services provided to a customer.

Regulations: Means any regulations developed and promulgated by the Commission according to the Bangladesh Energy Regulatory Commission Act, 2003 (Act No-13 of 2003), including subsequent amendments to the Act.

Schedule: It means a statement of the pricing format of electricity and the terms and conditions governing its applications.

Terms and Conditions of Service: Means a published document included as part of a licensee's tariff that establishes the licensee's terms and conditions for providing service to a customer, discussing such issues as the conditions under which connection will be provided to a customer metering, disconnection policies, payment instructions, consumer complaints procedures, etc. [6]

2.7 Electricity Situation at a Glance

Table No-2.1: Electricity Situation at a Glance [7]

Generation Capacity	17340 MW
Maximum Generation (19-09-2018)	11623 MW
Present Demand	11405 MW
Transmission Line(400kV)	698 Ckt. K.M
Transmission Line(230kV)	3343 Ckt. K.M
Transmission Line(132kV)	7082 Ckt. K.M
Distribution line (September 2016)	341000 KM
Transmission and distribution losses	12.19%
Per capita generation (29 October, 2017)	433KWh
Per capita generation (September 2016)	75.9 Million
Electricity Growth	12%

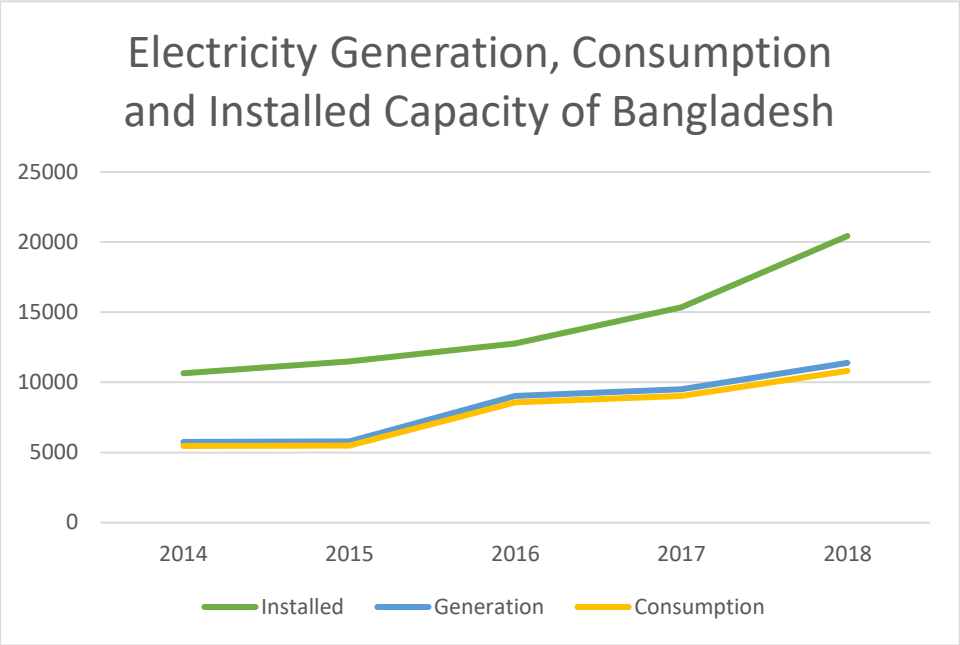


Figure-2.1: Electricity Generation, Consumption & Installed Capacity of Bangladesh [7].

Year-wise Electricity Generation

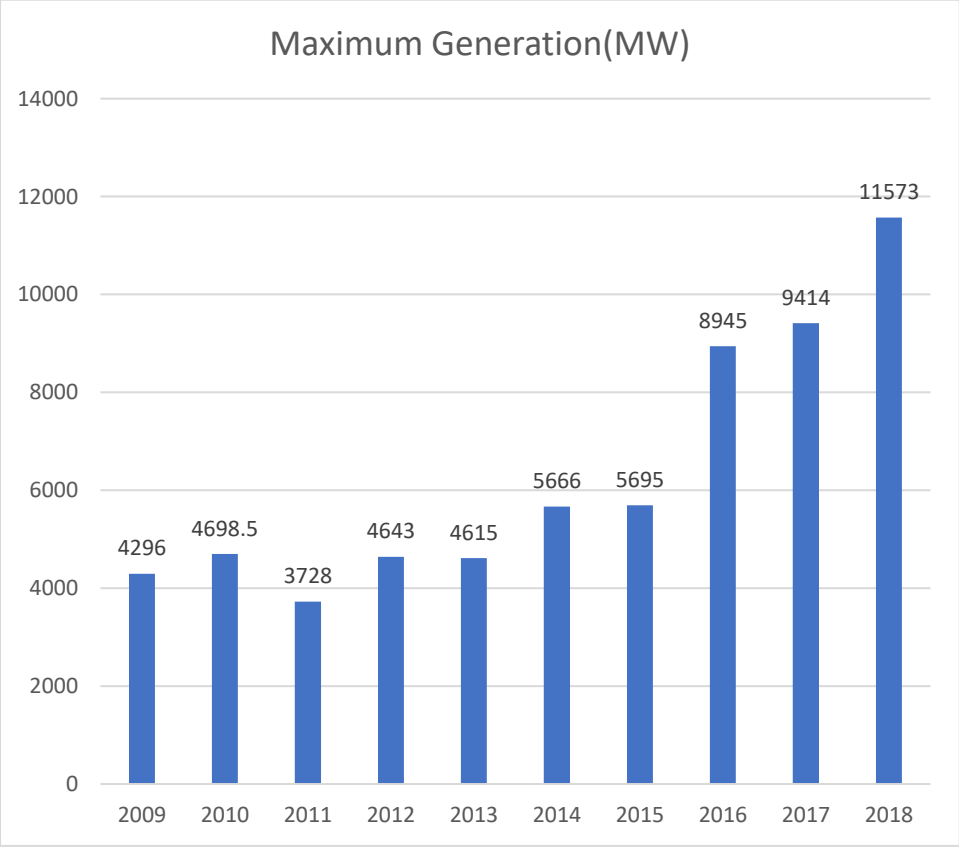


Figure-2.2: Year-wise Electricity Generation [7]

CHAPTER 3

PROJECT COST

3.1 Used and Useful Assets

In creating application for a tariff rate, or a modification within the tariff's terms and conditions, the electrical generation licensee should file a schedule that shows the first acquisition value of the quality, the accumulated depreciation, cyberspace quality price once reduction for accumulated depreciation, and also the quantity of the present depreciation to be enclosed within the Tariff Rate application for the check year. [6]

Generally, these assets must be used and useful for serving the licensee's customers. The asset accounts considered for a generation licensee are broken into three categories –

- Intangible Plant.
- Production plant.
- General plant.

3.2 Intangible Plant

An asset that is not physical in nature. Company holding (items equivalent to patents, trademarks, copyrights, and business methodologies), goodwill and complete recognition square measure all common intangible assets in today's marketplace. If an organization enters a legal agreement to work beneath another company's patent, with no plans of extending the agreement, it'd have a restricted life and would be classified as an explicit quality. [8]

Intangible Assets represent rights, privileges, and competitive advantages owned by a business. They are intangible only in the sense that they have no physical substance. Very often, their legal status may be of critical importance to the longevity of a company. Examples of intangible assets include: patents, copyrights, franchises, trademarks, and goodwill. Similar to plant assets (Which depreciate) and natural resources (Which deplete), intangibles are amortized. Normally, however, no

Accumulated Amortization account is used; the credit is made to the Asset account itself. Intangible plant would consist of organization, franchises and consents, and miscellaneous intangible plant. [9]

3.3 Production Plant

Production plant would come with land and land rights, structures and enhancements, accent electrical instrumentation and miscellaneous power station instrumentation. Steam production plants would to boot embody boiler plant instrumentation, engines and engine driven generators and turbo generator units. electricity plant would any embody reservoirs, dams and waterways, water wheels, turbines and generators, roads, railroads and bridges. Star thermal production units would also embody concentrating collectors, radiation observance instrumentation, engines and engine driven generators and turbo generator units. Star electrical phenomenon production units would come with the electrical phenomenon panels, mounting racks, radiation observance instrumentation, balance of system instrumentation and energy storage devices. Wind production units would come with the wind-powered generators, towers, wind observance instrumentation and balance of system instrumentation. Different production would any embody fuel holders, producers and accessories, prime movers and generators.

3.4 General Plant

A power station, additionally said as an influence plant or powerhouse and generally generating station or generating plant, is associate industrial facility for the generation of electrical power. Most power stations contain one or a lot of generators, a rotating machine that converts mechanical power into power. General plant would include land and land rights, structures and improvements, office furniture and equipment, transportation equipment, stores equipment, tools, shop and garage equipment, laboratory equipment, power operated equipment, communication equipment, miscellaneous equipment and other tangible property. [6]

CHAPTER 4

FIXED COST

4.1 Depreciation

The amount of depreciation enclosed as a value is that the total annual depreciation for all used and helpful assets for the check year. The quantity of the present depreciation is accessorial as associate expense in total prices at the present value of the assets and isn't subject to rating based upon any consequent revision of the quality valuation. [6]

Corporations record depreciation on all plant assets except land. Since the quantity of depreciation is also relatively large, depreciation expense is commonly a big consider deciding profits. For this reason, most financial plan users have an interest within the quantity of, and the methods accustomed reason, a company's depreciation expense. Depreciation is that the quantity of plant quality price allotted to every accounting amount profiting from the plant asset's use. Depreciation may be a method of allocation, not valuation. Eventually, all assets except land wear out or become therefore inadequate or passes that they're sold-out or discarded; so, firms must record depreciation on each plant quality except land. They record depreciation even when the value of a plant quality quickly rises higher than its original price as a result of eventually the quality is not any longer helpful to its current owner. [10]

$$\textit{Annual Depreciation} = \frac{\textit{Total Capital} - \textit{Salvage Value}}{\textit{Plant Life}}$$

4.2 Loan

In finance, a loan may be a debt provided by associate entity (Organization or Individual) entity at a rate of interest, and proved by a note that specifies, among alternative things, the principal quantity, of interest and date of reimbursement. A loan entails the reallocation of the topic asset(s) for an amount of your time, between the loaner and also the receiver

In a loan, the borrower initially receives or borrows an amount of money, known as the

principal, from the loaner associated is indebted to pay back or repay an equal quantity of cash to the loaner at a later time.

The loan is mostly provided at a value, noted as interest on the debt that provides associate incentive for the loaner to have interaction within the loan. During a legal loan, every of those obligations and restrictions is enforced by contract, which might conjointly place the receiver below extra restrictions called loan covenants. Though this text focuses on financial loans, in observe any material object could be season. [11]

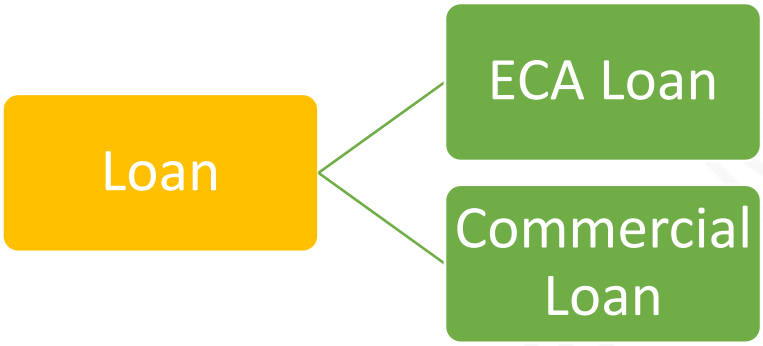


Figure-4.1: Types of Loan.

4.3 Export Credit Agency (ECA) Loan

A financial organization or agency that gives trade funding to domestic corporations for his or her international activities.

Credit agencies (ECAs) give funding services akin to guarantees, loans and insurance to those corporations so as to push exports within the domestic country. The first objective of ECAs is to get rid of the chance and uncertainty of payments to exporters once commerce outside their country. ECAs take the chance off from the bourgeois and shift it to themselves, for a premium. ECAs conjointly underwrite the industrial and political risks of investments in overseas markets that are usually deemed to be high risk. [12]

4.4 Commercial Loan

A **commercial loan** is a debt-based funding arrangement between a business and a financial institution such as a bank, typically used to fund major capital expenditures and/or cover operational costs that the company may otherwise be unable to afford, as opposed to a loan

made to an individual. [13]

Loan advanced to a business rather than to a client. Business loans are sometimes for a short-run, secured (Backed by a Collateral) or unsecured, and are typically advanced for finance instrumentality, machinery, or inventory. Banks sometimes need the business borrowers to submit monthly and annual money statements, and to take care of insurance cowl on the supported item. [14]

4.5 Equity

Equity is the difference between the value of the assets/interest and the cost of the liabilities of something owned. For example, if someone owns a machine worth $15,000 but owes $5,000 on that machine, the machine represents $10,000 equity. Equity can be negative if liability exceeds assets. Equity is the value of an asset less the value of all liabilities on that asset.

When starting a business, the owners put funds into the business to finance various business operations. Under the model of a private limited company, the business and its owners are separate entities, so the business is considered to owe these funds to its owners as a liability in the form of share capital. Throughout the business's existence, the value (equity) of the business will be the difference between its assets (The value it provides) and its liabilities (The costs, such as the initial investments, which its owners and other creditors put into it). [15]

4.6 Return on Equity

The return on equity represents investor's expectations of the returns of an investment of comparable risks elsewhere in that country.

The Commission's preference in decisive the come back on equity could be a type of a capital quality evaluation model (CAPM). It assumes that the value of equity is that the sum of a riskless rate of come back, and a comeback to compensate investors for market risk. It's the responsibility of the retailer applying for a tariff rate amendment to advocate a rate of come back on equity and supply adequate support to justify that Tariff Rate.

4.7 Regulatory Working Capital (RWC)

The last major element is regulatory working capital. In licensee tariff rate design, 'regulatory working capital' has a different meaning than the term 'working capital' in normal accounting. Regulatory working capital is a measure of licensee funding of daily
operating expenditures and a variety of non-plant investments that are necessary to sustain the ongoing operations of the licensee. The tariff rate establishment factor of regulatory working capital is designed to identify these ongoing funding requirements, on average, over a test year.

Fundamentally it is the normal operating funds of a licensee which carry it forward from month to month. It is the sum of the cash working capital, materials and supplies inventory and any prepayments made.

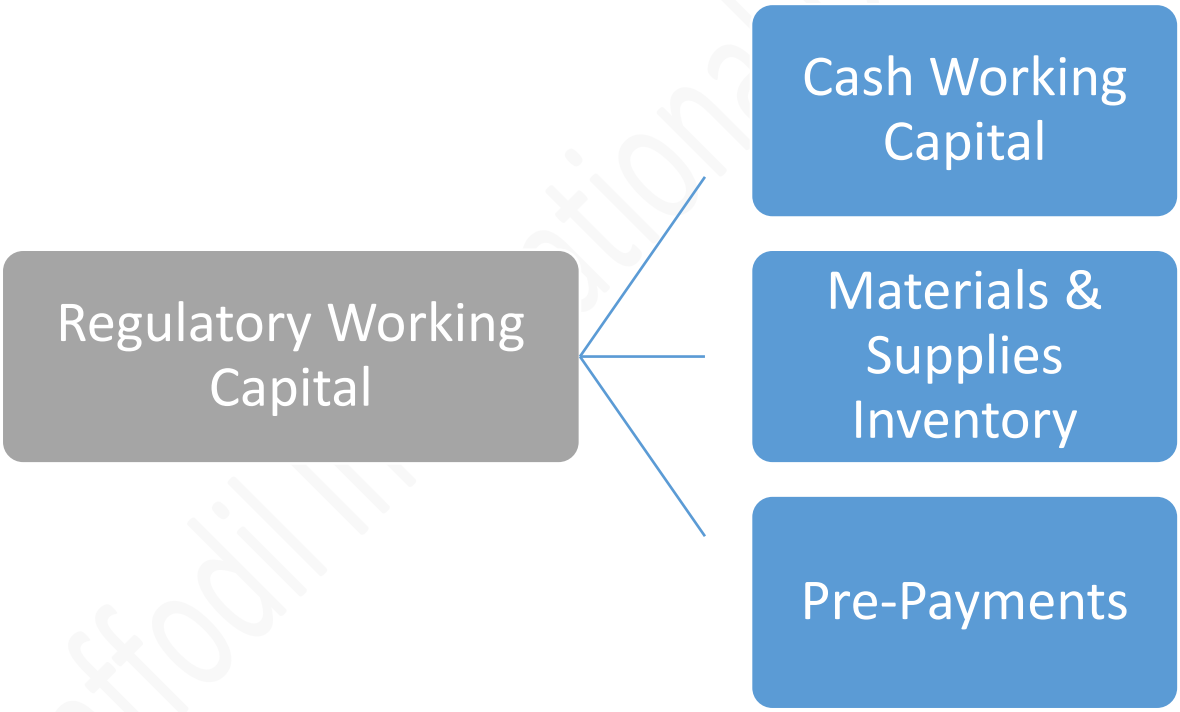


Figure-4.2: Parts of Regulatory Working Capital.

4.8 Cash Working Capital

Cash working capital represents the licensee provided cash required for payment of operation expenses, to maintain compensating cash balances and similar needs between the time the expenditures are necessary to provide the services and the time collections are received for the services.

For a licensee, the formula calculates 1/6th (Approximately 60 days) of operation and maintenance expenses for one year. For a well-managed natural monopoly, this computation represents the average time and amount that the licensee must provide cash for operations before collections are received from the service. This calculation would apply for generation.

$$\textbf{Cash Working Capital} = \frac{\textbf{\textit{Annual Operation \& Maintanence Cost}}}{\textbf{6}}$$

4.9 Materials & Supplies Inventory

Materials and supplies are the licensee's inventory value for material and supplies necessary to meet daily requirements of providing service. A 12-month average for the test year is used. Materials and supplies should be summarized for tariff rate setting purposes into two categories -Operation & Maintenance and Construction.

$$\textbf{Materials \& Supplies Inventory} = \frac{\textbf{\textit{Total amount of 1 year Materials and Supplies Cost}}}{\textbf{12}}$$

4.10 Pre-payments

Pre-payments are created ahead of the amount to that they apply and embrace things cherish pre-paid rents, insurance and taxes. The amounts ordinarily allowed are supported identical standards printed on top of for Materials & provides Inventories. the common monthly mensuration amount ought to cover quite one take a look at year review, since bound pre- paid expenses (Such as pre-paid insurance) usually are created for periods in far more than one year. Total the pre-paid balances over regardless of the longest cycle of anyone element of the pre-payment item and so average it for the take a look at year amount. [6]

$$\textbf{\textit{Pre- Payments}} = \frac{\textbf{\textit{One Average Year of Prepaid Item}}}{\mathbf{12}}$$

Example:

Regulatory Working Capital for Generation

Cash Working Capital	
(One-Sixth of Operation and Maintenance Expense)	2,586,360,000 Tk
Materials & Supplies	2,122,140,000 Tk
Pre-payments	45,000,000 Tk
Total Regulatory Working Capital	***4,753,500,000 Tk***

CHAPTER 5

VARIABLE COST

5.1 Fuel Cost

In electricity generation, fuel cost is the amount of cost that calculates for per unit generation. Each generation unit shall have a tariff rate part which is fuel cost, involved in the generation of the electricity. [6]

$$\textit{Total Fuel Cost} = \textit{Fuel Price} \times \textit{Fuel Consumption}$$

5.2 Important Terms for Calculation

Plant Factor: Plant Factor (The net capacity factor of a power plant) is the ratio of KWh generated o the total amount of energy the plant produced during a period of time to the product of plant capacity and the number of hours for which the plant was in operation. Capacity factors vary greatly depending on the type of fuel that is used and the design of the plant.

$$\textbf{Plant Factor} = \frac{\textit{Generated Electricity in MWh}}{\textit{Operating Capacity}(\textit{MW}) \times \textit{Hours in Current Month}}$$

A base load power plant with a capacity of 1,000 Megawatts (MW) might produce 648,000 Megawatt-Hours (MWh) in a 30-day month. The plant factor is 0.9 or 90%

$$\textit{Plant Factor} = \frac{648000}{1000 \times 30 \times 24} = 0.90 = 90\%$$

Heat Rate: Heat Rate means a measure of the thermal efficiency of a power plant. The measure is expressed in British thermal units per net Kilowatt-Hour of electricity. The lower

the plant's heat rate, the higher the plant's efficiency, because it requires fewer units of fuel input to produce a KWh of electricity.

$$\textbf{\textit{Heat Rate}} = \frac{\textbf{\textit{Calorific Value of Fuel} \times \textbf{\textit{Fuel Consumption}}}}{\textbf{\textit{Generated Electricity}}}$$

Calorific Value: The amount of heat produced by the complete combustion of a material or fuel. Measured in units of energy per amount of material, e.g. KJ/Kg.

In other words, calorific value (CV) is a measure of heating power and is dependent upon the composition of the gas. The CV refers to the amount of energy released when a known volume of gas is completely combusted under specified conditions.

Calorific Value of Gas: The CV of gas, which is dry, gross and measured at standard conditions of temperature and pressure, is usually quoted in Mega Joules per Cubic Meter (MJ/m3).

5.3 Non-Fuel or Operation & Maintenance Cost

This is the annual cost associated with the Salary & Allowance or Personnel Expenses, Repairs & Maintenance of Plant and Machineries, Lube oil, Grease & Vaseline, Administrative and others expenses of a power plant. Included are costs related to Operation & Maintenance, Employee Expenses and Miscellaneous costs such as Administrative Expenses. [16]

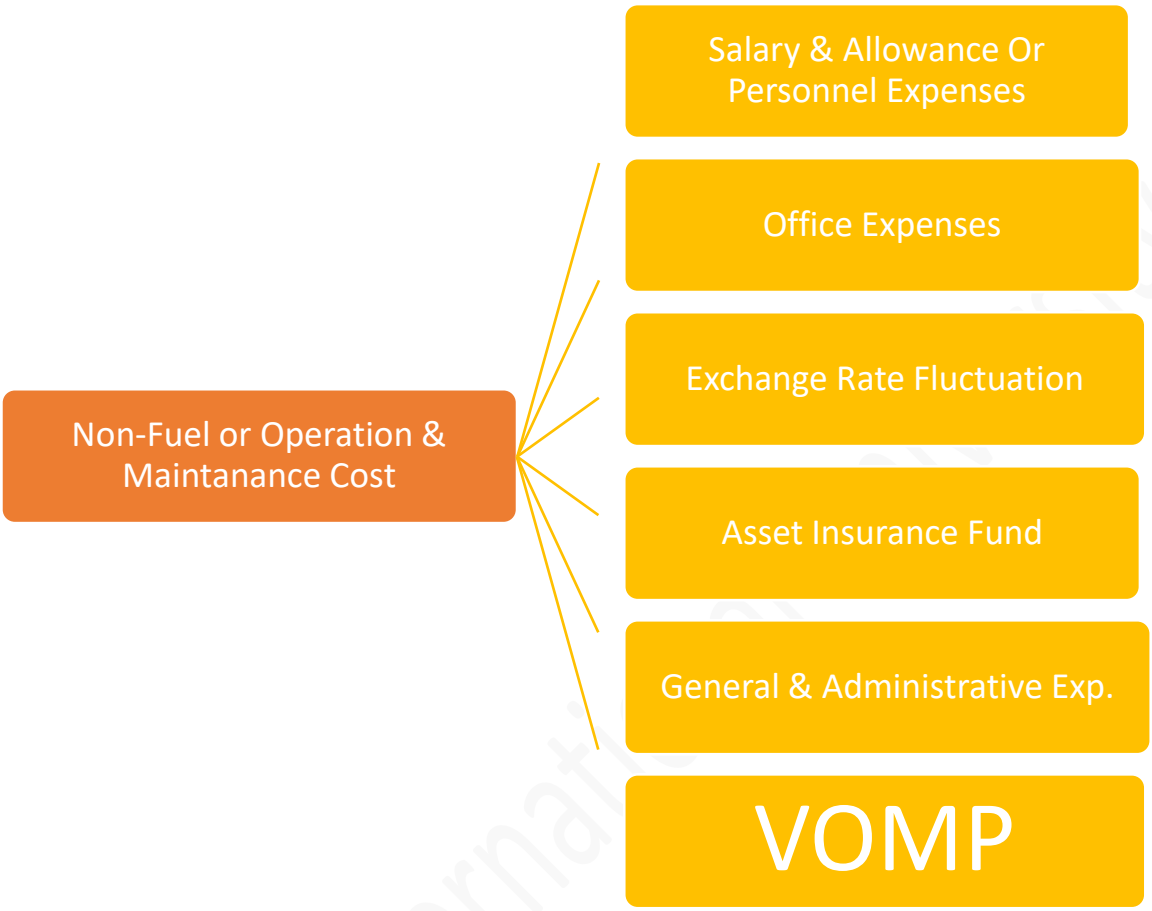


Figure-5.1: Parts of Non-Fuel or Operation & Maintenance Cost.

CHAPTER 6

TARIFF CALCULATION

6.1 Tariff Calculation Method

Each generation unit shall have a two-part tariff rate. One part will consist of the fixed cost and the other part will consist of the variable cost involved in the generation of the electricity.

For tariff calculation of Electricity Generation, following terms need to be calculated –

1. ***Fixed Cost***
   - Annual Depreciation
   - ECA Loan Calculation
   - Commercial Loan Calculation
   - Equity Calculation
   - Regulatory Working Capital
2. ***Variable Cost***
   - Fuel Cost
   - Non-Fuel or Operation & Maintenance Cost

This study develops an analytical model for electricity production cost accounting of power plants. The advantage of this approach is that it expressly examines the underlying structure of it. This study summarizes the tariff calculation of electricity generation. I've collected necessary information of many power plants from BERC (Bangladesh Energy regulative Commission). Then consistent with the quality formulas I actually have calculated the cost accounting details of power plants as well as fixed costs (Depreciation, Loan, Equity and regulative operating Capital) and Variable price (Fuel price and Non-Fuel or Operation & Maintenance Cost). And consistent with these prices is actually have determined monthly tariff price of electricity generation for many power plants.

6.2 Assumption Data-1

Name of Power Plant & Unit: Haripur CDC 360 MW Power Plant

Category of Technology: CC

Type of Fuel: Gas

For tariff calculation of Haripur CDC 360 MW Power Plant, the assumption data is given below –

Table No 6.1: Assumption Data-1

SL NO	Parameter/Assumption/Boundary Condition		Unit
1	Net Capacity of the Power Plant	360	Watt
2	Project Cost (USD 845.15/kW)	25697.29284	MTk
3	Exchange Rate	84.46	BDT/USD
4	Month Operation Hours	730	Hours
5	Calorific Value of Gas	1002.32	Kj/Cft
6	Fuel Price	79.82	Tk/KCft
7	Equity	30%	
8	Debt (70% of Total Rate Base)	70%	
9	Foreign/ECA Loan Facilities (60% of Total Debt)	60%	
10	Local/Commercial Loan facilities (40% of Total Debt)	40%	
11	Return on Equity	15%	
12	Rate of Interest of ECA Loan Facilities	10%	
13	Rate of Interest of Commercial Loan Facilities	10%	
14	Effective Plant Life	15	Years
15	Loan Repayment	10	Years
16	Salvage Value	5%	
17	Cash working capital	59.1667	MTk
18	Materials & Supplies	0.0000	
19	Pre-payments	0.0778	MTk
20	Interest on Regulatory Working Capital	10%	

6.3 Project Cost

Table No. 6.2: Project Cost

SL No	Item	Cost(10^6Tk)	Cost Tk	Share (%)
1	Intangible Plant	688.7	688687448.5	2.68%
2	Production Plant or Plant machinery and equipment		0.0	
2.1	Plant and machinery C&F,11/33 KV sub-station, Power Evacuation Line	21308.2	21308195221.0	82.92%
3	General Plant		0.0	
3.1	Land and Land Development	326.4	326355619.3	1.27%
3.2	Infrastructure (Building & Civil Works)	853.2	853150122.5	3.32%
3.3	Office Furniture and Equipment	25.7	25697292.8	0.10%
3.4	Laboratory Equipment	12.8	12848646.4	0.05%
3.5	Electric Equipment	12.8	12848646.4	0.05%
3.6	Transportation & Communication	174.7	174741591.4	0.68%
3.7	Miscellaneous Equipment	12.8	12848646.4	0.05%
3.8	Others tangible Equipment	12.8	12848646.4	0.05%
3.9	Interest During Construction	1066.4	1066437653.0	4.15%
3.1O	Contingencies	1202.6	1202633305.0	4.68%
4	Total Project Cost (1+2+3)	25697.3	25697292839.2	100.00%

6.4 Fixed Cost Calculation

6.4.1 Depreciation Calculation

Total project cost = 25697.29284*10^6 Tk

Salvage value = 5%

Plant life = 15 years

$$\text{Annual depreciation} = \frac{\text{Total Capital} - \text{Salvage Value}}{\text{Plant Life}}$$

$$= \frac{25697.29284*10\text{^}6-(25697.29284*10\text{^}6*5\%)}{15}$$

$$= 1627495213.15 \text{ TK}$$

$$\text{Monthly depreciation} = \frac{1627495213.15}{12}$$

$$= 135624601.10 \text{ TK}$$

6.4.2 ECA Loan Calculation

Given that,

Loan/Debt amount is 70% of Used & Useful Asset = $25697.29284\times10\text{^}6\times0.70$

$= 1.8*10^{10}$ Tk

60% of total debt amount that is ECA loan = $1.8*10^{10} \times 0.60$

$= 1.079*10^{10}$ Tk

∴ Principal, P = 10792862992 Tk

Yearly interest rate, r = 10%

Quarterly interest rate, (r/4) = 2.5%

Number of installments, n = 40

We Know,

$$\text{Principal} = A \times PVIFA$$

$$\Rightarrow 10792862992 = A \times \frac{1-\frac{1}{\left(1+\frac{r}{4}\right)^{n}}}{\frac{r}{4}}$$

$$\Rightarrow A = \frac{10792862992 \times \frac{r}{4}}{1-\frac{1}{\left(1+\frac{r}{4}\right)^{n}}}$$

$$\Rightarrow A = \frac{10792862992 \times \frac{10\%}{4}}{1-\frac{1}{\left(1+\frac{10\%}{4}\right)^{40}}}$$

$$\Rightarrow A = 429947007 \text{ TK}$$

∴ Every installment of ECA loan is 429947007 TK.

[Note: PVIFA – Present Value Interest Factor of Annuity]

This method shortly termed as Annuity method.

Definition of PVIFA:

A factor which can be used to calculate the present value of a series of annuities. The initial deposit, earning interest at the periodic rate (r), perfectly finances a series of (N) consecutive dollar withdrawals. PVIFA is also a variable used when calculating the present valued of an ordinary annuity.

Table No.6.3: ECA Loan Calculation

Quarters	Principal Beginning (Tk) (1)	Installment (Tk) (2)	Quarterly Interest (Tk) (3)=(1) x	Principal Repayment (Tk) (4)= (2)	Principal Ending (Tk) (5)= (1) – (4)	Yearly Interest (Tk)
1st	10792862992	429947007	269821575	160125432	10632737561	
2nd	10632737561	429947007	265818439	164128568	10468608993	
3rd	10468608993	429947007	261715225	168231782	10300377211	
4th	10300377211	429947007	257509430	172437576	10127939635	1054864669
5th	10127939635	429947007	253198491	176748516	9951191119	
6th	9951191119	429947007	248779778	181167229	9770023890	
7th	9770023890	429947007	244250597	185696409	9584327481	
8th	9584327481	429947007	239608187	190338820	9393988661	985837053
9th	9393988661	429947007	234849717	195097290	9198891371	
10th	9198891371	429947007	229972284	199974722	8998916649	
11th	8998916649	429947007	224972916	204974090	8793942558	
12th	8793942558	429947007	219848564	210098443	8583844116	909643481
13th	8583844116	429947007	214596103	215350904	8368493212	
14th	8368493212	429947007	209212330	220734676	8147758535	
15th	8147758535	429947007	203693963	226253043	7921505492	
16th	7921505492	429947007	198037637	231909369	7689596123	825540034
17th	7689596123	429947007	192239903	237707104	7451889019	
18th	7451889019	429947007	186297225	243649781	7208239238	
19th	7208239238	429947007	180205981	249741026	6958498212	
20th	6958498212	429947007	173962455	255984551	6702513661	732705565
21st	6702513661	429947007	167562842	262384165	6440129496	
22nd	6440129496	429947007	161003237	268943769	6171185727	
23rd	6171185727	429947007	154279643	275667363	5895518363	
24th	5895518363	429947007	147387959	282559048	5612959316	630233681
25th	5612959316	429947007	140323983	289623024	5323336292	
26th	5323336292	429947007	133083407	296863599	5026472692	
27th	5026472692	429947007	125661817	304285189	4722187503	
28th	4722187503	429947007	118054688	311892319	4410295184	517123895

29th	4410295184	429947007	110257380	319689627	4090605557	
30th	4090605557	429947007	102265139	327681868	3762923689	
31st	3762923689	429947007	94073092	335873914	3427049775	
32nd	3427049775	429947007	85676244	344270762	3082779012	392271855
33rd	3082779012	429947007	77069475	352877531	2729901481	
34th	2729901481	429947007	68247537	361699470	2368202012	
35th	2368202012	429947007	59205050	370741956	1997460055	
36th	1997460055	429947007	49936501	380010505	1617449550	254458564
37th	1617449550	429947007	40436239	389510768	1227938782	
38th	1227938782	429947007	30698470	399248537	828690245	
39th	828690245	429947007	20717256	409229751	419460494	
40th	419460494	429947007	10486512	419460494	0	102338477

Return on ECA Loan per year (Sum of yearly interest rate/10) = 640501727 Tk

Return on ECA Loan per month (Return on loan per year/12) = 53375143.9Tk

6.4.3 Commercial Loan Calculation

Given that,

Loan/Debt amount is 70% of Used & Useful Asset = 25697.29284×10^6×0.70

= $1.8*10^{10}$ Tk

40% of total debt amount that is Commercial loan = $1.8*10^{10} \times 0.40$

= 7195241995 Tk

∴ Principal, P = 7195241995 Tk

Yearly interest rate, r = 10%

Quarterly interest rate, (r/4) = 2.5%

Number of installments, n = 40

We Know,

$$\text{Principal} = A \times PVIFA$$

$$\Rightarrow 7195241995 = A \times \frac{1-\frac{1}{\left(1+\frac{r}{4}\right)^{n}}}{\frac{r}{4}}$$

$$\Rightarrow A = \frac{7195241995 \times \frac{r}{4}}{1-\frac{1}{\left(1+\frac{r}{4}\right)^{n}}}$$

$$\Rightarrow A = \frac{7195241995 \times \frac{10\%}{4}}{1-\frac{1}{\left(1+\frac{10\%}{4}\right)^{40}}}$$

$$\Rightarrow A = 286631338 \text{ TK}$$

∴ Every installment of commercial loan is 286631338 TK.

[Note: PVIFA – Present Value Interest Factor of Annuity]

This method shortly termed as Annuity method.

Definition of PVIFA:

A factor which can be used to calculate the present value of a series of annuities. The initial deposit, earning interest at the periodic rate (r), perfectly finances a series of (N) consecutive dollar withdrawals. PVIFA is also a variable used when calculating the present valued of an ordinary annuity.

Table No6..4: Commercial Loan Calculation

Quarters	Principal Beginning	Installment (Tk) (2)	Quarterly Interest (Tk) (3) =(1) x	Principal Repayment (Tk) (4) = (2)	Principal Ending (Tk)	Yearly Interest (Tk)
1st	7195241995	286631338	179881050	106750288	7088491707	
2nd	7088491707	286631338	177212293	109419045	6979072662	
3rd	6979072662	286631338	174476817	112154521	6866918141	
4th	6866918141	286631338	171672954	114958384	6751959757	703243113
5th	6751959757	286631338	168798994	117832344	6634127413	
6th	6634127413	286631338	165853185	120778152	6513349260	
7th	6513349260	286631338	162833732	123797606	6389551654	
8th	6389551654	286631338	159738791	126892546	6262659108	657224702
9th	6262659108	286631338	156566478	130064860	6132594247	
10th	6132594247	286631338	153314856	133316482	5999277766	
11th	5999277766	286631338	149981944	136649394	5862628372	
12th	5862628372	286631338	146565709	140065628	5722562744	606428987
13th	5722562744	286631338	143064069	143567269	5578995475	
14th	5578995475	286631338	139474887	147156451	5431839024	
15th	5431839024	286631338	135795976	150835362	5281003661	
16th	5281003661	286631338	132025092	154606246	5126397415	550360023
17th	5126397415	286631338	128159935	158471402	4967926013	
18th	4967926013	286631338	124198150	162433187	4805492825	
19th	4805492825	286631338	120137321	166494017	4638998808	
20th	4638998808	286631338	115974970	170656368	4468342441	488470377
21st	4468342441	286631338	111708561	174922777	4293419664	
22nd	4293419664	286631338	107335492	179295846	4114123818	
23rd	4114123818	286631338	102853095	183778242	3930345575	
24th	3930345575	286631338	98258639	188372698	3741972877	420155787
25th	3741972877	286631338	93549322	193082016	3548890861	
26th	3548890861	286631338	88722272	197909066	3350981795	
27th	3350981795	286631338	83774545	202856793	3148125002	

28th	3148125002	286631338	78703125	207928213	2940196789	344749263
29th	2940196789	286631338	73504920	213126418	2727070371	
30th	2727070371	286631338	68176759	218454578	2508615793	
31st	2508615793	286631338	62715395	223915943	2284699850	
32nd	2284699850	286631338	57117496	229513842	2055186008	261514570
33rd	2055186008	286631338	51379650	235251688	1819934321	
34th	1819934321	286631338	45498358	241132980	1578801341	
35th	1578801341	286631338	39470034	247161304	1331640037	
36th	1331640037	286631338	33291001	253340337	1078299700	169639043
37th	1078299700	286631338	26957492	259673845	818625855	
38th	818625855	286631338	20465646	266165691	552460163	
39th	552460163	286631338	13811504	272819834	279640330	
40th	279640330	286631338	6991008	279640330	0	68225651

Return on Commercial Loan per year (Sum of yearly interest rate/10) = 427001151.6 Tk

Return on Commercial Loan per month (Return on loan per year/12) = 35583429.3 Tk

6.4.4 Equity Calculation

Given that,

Equity amount is 30% of total rate base.

Since total rate base is $= 1.8*10^{10}$ Tk

Therefore, Equity amount $= 1.8*10^{10} \times 0.30$

$= 7709187852$ TK

Principal, P = 7709187852 Tk

Return on equity rate, r = 15%

Effective plant life, n = 15 years

We Know,

$$\text{Principal} = A \times PVIFA$$

$$\Rightarrow 7709187852 = A \times \frac{1-\frac{1}{(1+r)^n}}{\frac{r}{4}}$$

$$\Rightarrow A = \frac{7709187852 \times r}{1-\frac{1}{(1+r)^n}}$$

$$\Rightarrow A = \frac{7709187852 \times 15\%}{1-\frac{1}{(1+15\%)^{15}}}$$

$$\Rightarrow A = 1318402585 \text{ TK}$$

[Note: PVIFA – Present Value Interest Factor of Annuity]

This method shortly termed as Annuity method.

Definition of PVIFA:

A factor which can be used to calculate the present value of a series of annuities. The initial deposit, earning interest at the periodic rate (r), perfectly finances a series of (N) consecutive dollar withdrawals. PVIFA is also a variable used when calculating the present valued of an ordinary annuity.

Table No. 6.5: Equity Calculation

Quarters	Principal Beginning (Tk) (1)	Installment (Tk) (2)	Yearly Interest (Tk) (3)= (1) x (0.15)	Principal Repayment (Tk) (4)= (2)	Principal Ending (Tk) (5)= (1) – (4)
1st	7709187852	1318402585	1156378178	162024407	7547163445
2nd	7547163445	1318402585	1132074517	186328068	7360835377
3rd	7360835377	1318402585	1104125307	214277278	7146558099
4th	7146558099	1318402585	1071983715	246418870	6900139229
5th	6900139229	1318402585	1035020884	283381700	6616757528
6th	6616757528	1318402585	992513629	325888955	6290868573
7th	6290868573	1318402585	943630286	374772299	5916096274
8th	5916096274	1318402585	887414441	430988144	5485108131

9th	5485108131	1318402585	822766220	495636365	4989471765
10th	4989471765	1318402585	748420765	569981820	4419489946
11th	4419489946	1318402585	662923492	655479093	3764010853
12th	3764010853	1318402585	564601628	753800957	3010209896
13th	3010209896	1318402585	451531484	866871100	2143338796
14th	2143338796	1318402585	321500819	996901765	1146437030
15th	1146437030	1318402585	171965555	1146437030	0

Return on Equity per year (Sum of yearly interest rate/15) = 804456728 Tk

Return on Equity per month (Return on Equity per year/12) = 67038060.7 Tk

6.5 Total Fixed Cost & Per Unit Fixed Cost

Table No.6.6: Total Fixed Cost

Item	Monthly	Yearly
Depreciation expense (Tk)	135624601.10	1627495213.15
ECA Loan (Tk)	53375143.95	640501727.39
Commercial Loan (Tk)	35583429.30	427001151.59
Return on equity (Tk)	67038060.66	804456727.92
Regulatory Working Capital (Tk)	493703.56	5924442.74
Total amount (Tk)	292114938.57	3505379262.79
Total amount (MTk)	292.11	3505.38

6.6 Variable Cost Calculation

Table No.6.7: Power production Statement

Month	Fuel Consumption (MCFT)	Electricity Generation (MKWh)	Operating Capacity (MW)
July	1590.09	219.66	360
Aug	1588.06	219.21	360
Sept	1579.05	210.63	360
Oct	1574.55	218.46	360
Nov	1572.30	211.01	360
Dec	1563.29	219.21	360
Jan	1583.56	219.21	360
Feb	1576.80	201.61	360
Mar	1590.32	219.21	360
April	1556.53	211.76	360
May	1570.04	219.21	360
June	1555.40	211.84	360

$$\text{Per unit fixed cost (yearly)} = \frac{\text{Total Amount of Fixed Cost}}{\text{Generated Electricity}}$$

$$= \frac{\mathbf{1938}}{\mathbf{2581}} \textbf{ TK/KWh}$$

$$= 0.75 \textbf{ TK/KWh}$$

6.6.1 Fuel Cost Calculation (July)

Operating capacity = 360 MW

Generated electricity = 219.66 MKWh

Calorific Value of Gas = 1002.3 KJ/CFT

Fuel Price = 79.82 Tk/KCF

Fuel consumption = 1590.09 MCFT

Hours in current month = 730 hours

$$Plant\ Factor = \frac{\text{Generated Electricity in KWh}}{\text{Operating Capacity} \times 1000 \times \text{Hours in Current Month}} \times 100\%$$

$$= \frac{219.66 \times 10^6}{360 \times 1000 \times 730} \times 100\%$$

$$= 82.79\ \%$$

$$Heat\ Rate = \frac{\text{Calorific Value of Fuel} \times \text{Fuel Consumtion}}{\text{Generated Electricity}}$$

$$= \frac{1002.3 \times 0.23923 \times 1000 \times 1590.09}{219.66}$$

$$= 1735.77\ (\text{Kcal/KWh})$$

Total fuel cost = Fuel price × Fuel consumtion

= 79.82 Tk/KCFT × 1590.09 MCFT

= *126.9 MTk*

$$\text{Fuel cost per unit energy} = \frac{\text{Total Fuel Cost}}{\text{Generated Electricity}}$$

$$= \frac{126.9}{219.66}$$

$$= 0.578\ Tk/KWh$$

6.6.2 Non-Fuel or Operation & Maintenance Cost Calculation (July)

Table No. 6.8: Components for Non-Fuel Cost (MTk)

Month	Total Personnel Exp. (MTK)	Office Expenses	Exchange Rate	Assets Insurance	Fund General & Administrativ	VOMP	Total Non-Fuel Cost
July	6.90	0.40	12.90	0.08	8.10	1.43	29.80
Aug	6.87	0.40	12.85	0.08	8.06	1.42	29.68
Sept	6.82	0.39	12.75	0.08	8.01	1.41	29.46
Oct	6.68	0.39	12.50	0.08	7.84	1.39	28.87
Nov	6.92	0.40	12.95	0.08	8.13	1.43	29.92
Dec	6.64	0.38	12.42	0.08	7.80	1.38	28.69
Jan	6.88	0.40	12.86	0.08	8.08	1.42	29.72
Feb	6.87	0.40	12.85	0.08	8.06	1.42	29.68
Mar	6.91	0.40	12.93	0.08	8.11	1.43	29.86
April	6.89	0.40	12.90	0.08	8.09	1.43	29.78
May	6.87	0.40	12.85	0.08	8.06	1.42	29.68
June	6.91	0.40	12.92	0.08	8.11	1.43	29.85

Generated Electricity = 219.66 MKwh

Total Non-Fuel or O & M Cost = 29.80 MTk

Per Unit Non-Fuel or O & M Cost = $\frac{Non-Fuel\ Cost\ (MTK)}{Generated\ Electricity (MKwh)}$

$$= \frac{29.80\ MTk}{219.66\ MKwh}$$

=0.136 Tk/Kwh

6.7 Chart of Cost

Table No 6.9: Chart of Cost

Month	Plant Factor %	Heat Rate (KCal/Kwh)	Total Fuel Cost	Per Unit Fuel Cost (TK/Kwh)	Fixed Cost (MTk)	Per Unit Fixed Cost (Tk/Kwh)	Non-Fuel or O & M	Per Unit Non-Fuel or O & M Cost	Total Cost (MTk)	Per Unit Total Cost (Tk/Kwh)
July	83.58%	1735.8	126.9	0.58	292.1	1.3	29.8	0.136	448.8	2.0
Aug	83.41%	1737.1	126.8	0.58	292.1	1.3	29.7	0.135	448.6	2.0
Sept	80.15%	1797.6	126.0	0.60	292.1	1.4	29.5	0.140	447.6	2.1
Oct	83.13%	1728.3	125.7	0.58	292.1	1.3	28.9	0.132	446.7	2.0
Nov	80.29%	1786.7	125.5	0.59	292.1	1.4	29.9	0.142	447.5	2.1
Dec	83.41%	1710.0	124.8	0.57	292.1	1.3	28.7	0.131	445.6	2.0
Jan	83.41%	1732.2	126.4	0.58	292.1	1.3	29.7	0.136	448.2	2.0
Feb	76.72%	1875.4	125.9	0.62	292.1	1.4	29.7	0.147	447.7	2.2
Mar	83.41%	1739.6	126.9	0.58	292.1	1.3	29.9	0.136	448.9	2.0
April	80.58%	1762.6	124.2	0.59	292.1	1.4	29.8	0.141	446.1	2.1
May	83.41%	1717.4	125.3	0.57	292.1	1.3	29.7	0.135	447.1	2.0
June	80.61%	1760.6	124.2	0.59	292.1	1.4	29.8	0.141	446.1	2.1

6.8 Assumption Data-2

Name of Power Plant & Unit: Barapukuria 1st unit 200 MW Power Plant

Category of Technology: CC

Type of Fuel: Coal

For tariff calculation of Barapukuria 1st unit 200 MW Power Plant, the assumption data is given below –

Table No 6.10: Assumption Data-2

SL NO	Parameter/Assumption/Boundary Condition		Unit
1	Net Capacity of the Power Plant	200	MW
2	Project Cost (USD 845.15/kW)	14276.27	MTK
3	Exchange Rate	84.46	BDT/USD
4	Month Operation Hours	730	Hours
5	Calorific Value of Coal	6072	Kj/kg
6	Fuel Price	10400	Tk/Ton
7	Equity	30%	
8	Debt (70% of Total Rate Base)	70%	
9	Foreign/ECA Loan Facilities (70% of Total Debt)	60%	
10	Local/Commercial Loan facilities (30% of Total Debt)	40%	
11	Return on Equity	8%	
12	Rate of Interest of ECA Loan Facilities	8%	
13	Rate of Interest of Commercial Loan Facilities	8%	
14	Effective Plant Life	15	Years
15	Loan Repayment	10	Years
16	Salvage Value	5%	
17	Cash working capital	113.00	MTk
18	Materials & Supplies	0.00	MTk
19	Pre-payments	0.15	MTk
20	Interest on regulatory working capital	13.0%	

6.9 Project Cost

Table No. 6.11: Project Cost

SL No	Item	Cost(10^6Tk)	Cost (Tk)	Share (%)
1	Intangible Plant	382.6041378	382604137.8	2.68%
2	Production Plant or Plant machinery and equipment	0		
2.1	Plant and machinery C&F,11/33 KV sub-station, Power Evacuation Line	11837.88624	11837886240	82.92%
3	General Plant	0		
3.1	Land and Land Development	181.3086772	181308677.2	1.27%
3.2	Infrastructure (Building & Civil Works)	473.97229	473972290	3.32%
3.3	Office Furniture and Equipment	14.2762738	14276273.8	0.10%
3.4	Laboratory Equipment	7.138136899	7138136.899	0.05%
3.5	Electric Equipment	7.138136899	7138136.899	0.05%
3.6	Transportation & Communication	97.07866183	97078661.83	0.68%
3.7	Miscellaneous Equipment	7.138136899	7138136.899	0.05%
3.8	Others tangible Equipment	7.138136899	7138136.899	0.05%
3.9	Interest During Construction	592.4653627	592465362.7	4.15%
3.1O	Contingencies	668.1296137	668129613.7	4.68%
4	Total Project Cost (1+2+3)	14276.27	14276273805	100%

6.10 Fixed Cost Calculation

6.10.1 Depreciation Calculation

Total project cost = 14276.27*10^6 Tk

Salvage value = 5%

Plant life = 15 years

$$\text{Annual depreciation} = \frac{\text{Total Capital} - \text{Salvage Value}}{\text{Plant Life}}$$

$$= \frac{14276.27*10\text{^}6-(14276.27*10\text{^}6*5\%)}{15}$$

$$= 904164007.6 \text{ TK}$$

$$\text{Monthly depreciation} = \frac{904164007.6}{12}$$

$$= 75347000.64 \text{ TK}$$

6.10.2 ECA Loan Calculation

Given that,

Loan/Debt amount is 70% of Used & Useful Asset = 14276.27×10^6×0.70

= 9993389000 Tk

60% of total debt amount that is ECA loan = 9993389000× 0.60

= 5996034998 Tk

∴ Principal, P = 5996034998 Tk

Yearly interest rate, r = 8%

Quarterly interest rate, (r/4) = 2%

Number of installments, n = 40

We Know,

Principal = A×PVIFA

$$\Rightarrow 5996034998 = A \times \frac{1-\frac{1}{\left(1+\frac{r}{4}\right)^n}}{\frac{r}{4}}$$

$$\Rightarrow A = \frac{5996034998 \times \frac{r}{4}}{1-\frac{1}{\left(1+\frac{r}{4}\right)^n}}$$

$$\Rightarrow A = \frac{5996034998 \times \frac{8\%}{4}}{1-\frac{1}{\left(1+\frac{8\%}{4}\right)^{40}}}$$

=> A = 219189543 TK

∴ Every installment of ECA loan is 219189543 TK.

[Note: PVIFA – Present Value Interest Factor of Annuity]

This method shortly termed as Annuity method.

Definition of PVIFA:

A factor which can be used to calculate the present value of a series of annuities. The initial deposit, earning interest at the periodic rate (r), perfectly finances a series of (N) consecutive dollar withdrawals. PVIFA is also a variable used when calculating the present valued of an ordinary annuity.

Table No.6.12: ECA Loan Calculation

Quarters	Principal Beginning (Tk) (1)	Installment (Tk) (2)	Quarterly Interest (Tk) (3)=(1)	Principal Repayment (Tk) (4)= (2)	Principal Ending (Tk) (5)= (1) – (4)	Yearly Interest (Tk)
1st	5996034998	219189543	119920700	99268843	5896766155	
2nd	5896766155	219189543	117935323	101254220	5795511935	
3rd	5795511935	219189543	115910239	103279304	5692232630	
4th	5692232630	219189543	113844653	105344891	5586887740	467610914
5th	5586887740	219189543	111737755	107451788	5479435951	
6th	5479435951	219189543	109588719	109600824	5369835127	
7th	5369835127	219189543	107396703	111792841	5258042286	
8th	5258042286	219189543	105160846	114028697	5144013589	433884022
9th	5144013589	219189543	102880272	116309271	5027704318	
10th	5027704318	219189543	100554086	118635457	4909068861	
11th	4909068861	219189543	98181377	121008166	4788060695	
12th	4788060695	219189543	95761214	123428329	4664632366	397376949

13th	4664632366	219189543	93292647	125896896	4538735470	
14th	4538735470	219189543	90774709	128414834	4410320636	
15th	4410320636	219189543	88206413	130983130	4279337506	
16th	4279337506	219189543	85586750	133602793	4145734712	357860520
17th	4145734712	219189543	82914694	136274849	4009459864	
18th	4009459864	219189543	80189197	139000346	3870459518	
19th	3870459518	219189543	77409190	141780353	3728679165	
20th	3728679165	219189543	74573583	144615960	3584063205	315086665
21st	3584063205	219189543	71681264	147508279	3436554926	
22nd	3436554926	219189543	68731099	150458445	3286096481	
23rd	3286096481	219189543	65721930	153467614	3132628868	
24th	3132628868	219189543	62652577	156536966	2976091902	268786870
25th	2976091902	219189543	59521838	159667705	2816424197	
26th	2816424197	219189543	56328484	162861059	2653563138	
27th	2653563138	219189543	53071263	166118280	2487444857	
28th	2487444857	219189543	49748897	169440646	2318004211	218670482
29th	2318004211	219189543	46360084	172829459	2145174752	
30th	2145174752	219189543	42903495	176286048	1968888704	
31st	1968888704	219189543	39377774	179811769	1789076935	
32nd	1789076935	219189543	35781539	183408004	1605668930	164422892
33rd	1605668930	219189543	32113379	187076165	1418592766	
34th	1418592766	219189543	28371855	190817688	1227775078	
35th	1227775078	219189543	24555502	194634042	1033141036	
36th	1033141036	219189543	20662821	198526722	834614314	105703556
37th	834614314	219189543	16692286	202497257	632117057	
38th	632117057	219189543	12642341	206547202	425569855	
39th	425569855	219189543	8511397	210678146	214891709	
40th	214891709	219189543	4297834	214891709	0	42143859

Return on ECA Loan per year (Sum of yearly interest rate/10) =277154672.9 Tk

Return on ECA Loan per month (Return on loan per year/12) = 2309622.74 Tk

6.10.3 Commercial Loan Calculation

Given that,

Loan/Debt amount is 70% of Used & Useful Asset = 14276.27×10^6×0.70

= 9993389000 Tk

40% of total debt amount that is ECA loan = 9993389000 × 0.40

= 146126362 Tk

∴ Principal, P = 146126362 Tk

Yearly interest rate, r = 8%

Quarterly interest rate, (r/4) = 2%

Number of installments, n = 40

We Know,

Principal = A×PVIFA

$$\Rightarrow 146126362 = A \times \frac{1-\frac{1}{\left(1+\frac{r}{4}\right)^{n}}}{\frac{r}{4}}$$

$$\Rightarrow A = \frac{146126362 \times \frac{r}{4}}{1-\frac{1}{\left(1+\frac{r}{4}\right)^{n}}}$$

$$\Rightarrow A = \frac{146126362 \times \frac{8\%}{4}}{1-\frac{1}{\left(1+\frac{8\%}{4}\right)^{40}}}$$

=> A = 79947133 TK

∴ Every installment of commercial loan is 79947133 TK.

[Note: PVIFA – Present Value Interest Factor of Annuity]

This method shortly termed as Annuity method.

Definition of PVIFA:

A factor which can be used to calculate the present value of a series of annuities. The initial deposit, earning interest at the periodic rate (r), perfectly finances a series of (N) consecutive

dollar withdrawals. PVIFA is also a variable used when calculating the present valued of an ordinary annuity.

Table No.6.13: Commercial Loan Calculation

Installment (Tk) (2)	Quarterly Interest (Tk) (3)=(1) x (.03)	Principal Repayment (Tk) (4)= (2) – (3)	Principal Ending (Tk) (5)= (1) –	Yearly Interest (Tk)
146126362	79947133	66179229	3931177436	
146126362	78623549	67502813	3863674623	
146126362	77273492	68852870	3794821753	
146126362	75896435	70229927	3724591826	311740610
146126362	74491837	71634526	3652957301	
146126362	73059146	73067216	3579890085	
146126362	71597802	74528560	3505361524	
146126362	70107230	76019132	3429342393	289256015
146126362	68586848	77539514	3351802878	
146126362	67036058	79090305	3272712574	
146126362	65454251	80672111	3192040463	
146126362	63840809	82285553	3109754910	264917966
146126362	62195098	83931264	3025823646	
146126362	60516473	85609889	2940213757	
146126362	58804275	87322087	2852891670	
146126362	57057833	89068529	2763823142	238573680
146126362	55276463	90849899	2672973242	
146126362	53459465	92666897	2580306345	
146126362	51606127	94520235	2485786110	
146126362	49715722	96410640	2389375470	210057777
146126362	47787509	98338853	2291036617	
146126362	45820732	100305630	2190730987	
146126362	43814620	102311742	2088419245	
146126362	41768385	104357977	1984061268	179191246
146126362	39681225	106445137	1877616131	
146126362	37552323	108574039	1769042092	
146126362	35380842	110745520	1658296571	
146126362	33165931	112960431	1545336141	145780321

146126362	30906723	115219639	1430116501	
146126362	28602330	117524032	1312592469	
146126362	26251849	119874513	1192717957	
146126362	23854359	122272003	1070445954	109615261
146126362	21408919	124717443	945728511	
146126362	18914570	127211792	818516719	
146126362	16370334	129756028	688760691	
146126362	13775214	132351148	556409543	70469037
146126362	11128191	134998171	421411371	
146126362	8428227	137698135	283713237	
146126362	5674265	140452097	143261139	
146126362	2865223	143261139	0	28095906

Return on Commercial Loan per year (Sum of yearly interest rate/10) = 184769781.9 Tk

Return on Commercial Loan per month (Return on loan per year/12) = 15397481.83 Tk

6.10.4 Equity Calculation

Given that,

Equity amount is 30% of total rate base.

Since total rate base is =14276.27×10^6Tk

Therefore, Equity amount = 14276.27×10^6 × 0.30

= 4282882141 TK

Principal, P = 4282882141 Tk

Return on equity rate, r = 8%

Effective plant life, n = 15 years

We Know,

Principal = A×PVIFA

$$\Rightarrow 4282882141 = A \times \frac{1-\frac{1}{(1+r)^n}}{\frac{r}{4}}$$

$$\Rightarrow A = \frac{4282882141 \times r}{1-\frac{1}{(1+r)^n}}$$

$$\Rightarrow A = \frac{4282882141 \times 8\%}{1-\frac{1}{(1+8\%)^{15}}}$$

$$\Rightarrow A = 500367172 \text{ TK}$$

[Note: PVIFA – Present Value Interest Factor of Annuity]

This method shortly termed as Annuity method.

Definition of PVIFA:

A factor which can be used to calculate the present value of a series of annuities. The initial deposit, earning interest at the periodic rate (r), perfectly finances a series of (N) consecutive dollar withdrawals. PVIFA is also a variable used when calculating the present valued of an ordinary annuity.

Table No.6.14: Equity Calculation

Quarters	Principal Beginning (Tk) (1)	Installment (Tk) (2)	Yearly Interest (Tk) (3)= (1) x (0.15)	Principal Repayment (Tk) (4)= (2) – (3)	Principal Ending (Tk) (5)= (1) – (4)
1st	4282882141	500367172	342630571	157736600	4125145541
2nd	4125145541	500367172	330011643	170355528	3954790013
3rd	3954790013	500367172	316383201	183983971	3770806042
4th	3770806042	500367172	301664483	198702688	3572103354
5th	3572103354	500367172	285768268	214598903	3357504451
6th	3357504451	500367172	268600356	231766816	3125737635
7th	3125737635	500367172	250059011	250308161	2875429474
8th	2875429474	500367172	230034358	270332814	2605096661
9th	2605096661	500367172	208407733	291959439	2313137222
10th	2313137222	500367172	185050978	315316194	1997821028
11th	1997821028	500367172	159825682	340541489	1657279539
12th	1657279539	500367172	132582363	367784808	1289494730
13th	1289494730	500367172	103159578	397207593	892287137
14th	892287137	500367172	71382971	428984201	463302937
15th	463302937	500367172	37064235	463302937	0

Return on Equity per year (Sum of yearly interest rate/15) = 214841696 Tk

Return on Equity per month (Return on Equity per year/12) = 17903474.6 Tk

6.11 Total Fixed Cost & Per Unit Fixed Cost

Table No.6.15: Total Fixed Cost

Item	Monthly	Yearly
Depreciation expense (Tk)	75347000.64	904164007.6
ECA Loan (Tk)	23096222.74	277154672.9
Commercial Loan (Tk)	15397481.83	184769781.9
Return on equity (Tk)	17903474.63	214841695.5
Return on Regulatory Working Capital	1225775.547	14709306.57
Total amount (Tk)	**132969955.4**	**1595639464**
Total amount (MTk)	**132.9699554**	**1595.639464**

Table No.6.16: Power production Statement

Month	Fuel Consumption (MTon)	Electricity Generation (MKWh)	Operating Capacity (MW)
July	0.0409	71.26	200
Aug	0.0408	71.17	200
Sept	0.0406	70.77	200
Oct	0.0405	70.56	200
Nov	0.0403	70.46	200
Dec	0.0384	70.06	200
Jan	0.0410	70.97	200
Feb	0.0405	70.66	200
Mar	0.0395	71.27	200
April	0.0407	69.76	200
May	0.0410	70.36	200
June	0.0405	69.71	200

$$\text{Per unit fixed cost (yearly)} = \frac{\text{Total Amount of Fixed Cost}}{\text{Generated Electricity}}$$

$$= \frac{\mathbf{1595.639464}}{\mathbf{847}} \textbf{ TK/KWh}$$

$$= 1.8839 \textbf{ TK/KWh}$$

6.12 Variable Cost Calculation

6.12.1 Fuel Cost Calculation (July)

Operating capacity = 200 MW

Generated electricity = 71.26 MKWh

Calorific Value of Coal = 6072 KJ/KG

Fuel Price = 10400 Tk/Ton

Fuel consumption = 0.0409 MTon

Hours in current month = 730 hours

$$Plant\ Factor = \frac{\text{Generated Electricity in KWh}}{\text{Operating Capacity} \times 1000 \times \text{Hours in Current Month}} \times 100\%$$

$$= \frac{71.26 \times 10^6}{200 \times 1000 \times 730} \times 100\%$$

$$= 48.81\ \%$$

$$Heat\ Rate = \frac{\text{Calorific Value of Fuel} \times \text{Fuel Consumtion}}{\text{Generated Electricity}}$$

$$= \frac{6072 \times 1000 \times 0.0409}{71.26}$$

$$= 1735.77 \text{ (KJ/KWh)}$$

Total fuel cost = Fuel price × Fuel consumtion

= 10400 Tk/Ton × 0.4850 MTon

= 5044 MTk

$$\text{Fuel cost per unit energy} = \frac{\text{Total Fuel Cost}}{\text{Generated Electricity}}$$

$$= \frac{5044}{847}$$

$$= 5.955\ Tk/KWh$$

6.12.2 Non-Fuel or Operation & Maintenance Cost Calculation(July)

Table No. 6.17: Components for Non-Fuel Cost (MTk)

Month	Total Personnel	Office Expenses	Exchange Rate	Assets Insurance	General & Administrativ	VOMP (MTK)	Total Non-Fuel Cost
JULY	13.18	0.76	24.63	0.15	15.47	2.74	56.92
AUG	13.11	0.76	24.55	0.15	15.40	2.72	56.69
SEPT	13.03	0.74	24.36	0.15	15.30	2.69	56.26
OCT	12.75	0.74	23.87	0.15	14.98	2.65	55.14
NOV	13.22	0.76	24.74	0.15	15.53	2.74	57.13
DEC	12.69	0.72	23.72	0.15	14.89	2.63	54.80
JAN	13.13	0.76	24.57	0.15	15.42	2.72	56.75
FEB	13.11	0.76	24.55	0.15	15.40	2.72	56.69
MAR	13.20	0.76	24.70	0.15	15.49	2.74	57.03
APRIL	13.15	0.76	24.63	0.15	15.45	2.74	56.88
MAY	13.11	0.76	24.55	0.15	15.40	2.72	56.69
JUNE	13.20	0.76	24.67	0.15	15.49	2.74	57.01
TOTAL	**156.87**	**9.08**	**293.52**	**1.78**	**184.22**	**32.52**	**678**

Generated Electricity = 71.26 MKwh

Total Non-Fuel or Operation & Maintenance Cost = 56.92 MTk

Per unit Non-Fuel or O & M Cost = $\frac{Non-Fuel\ Cost\ (MTk)}{Generated\ Electricity(MKwh)}$

$$= \frac{56.92\ MTk}{71.26 MKwh}$$

= 0.8 Tk/Kwh

6.13 Chart of Cost

Table No.6.18: Chart of Cost

Month	Plant Factor %	Heat Rate (Kj/Kwh)	Total Fuel Cost (MTk)	Per Unit Fuel Cost (Tk/Kwh)	Fixed Cost (MTk)	Per Unit Fixed Cost (Tk/Kwh)	Non-Fuel or O & M Cost (MTk)	Per Unit Non-Fuel or O & M Cost (Tk)	Total Cost (MTk)	Per Unit Total Cost (Tk/Kwh)
July	48.81%	3487.77	425.69	5.97	132.97	1.87	56.92	0.80	615.58	8.64
Aug	48.75%	3483.58	424.64	5.97	132.97	1.87	56.69	0.80	614.30	8.63
Sept	48.47%	3486.07	422.53	5.97	132.97	1.88	56.26	0.80	611.76	8.64
Oct	48.33%	3487.32	421.47	5.97	132.97	1.88	55.14	0.78	609.59	8.64
Nov	48.26%	3474.86	419.37	5.95	132.97	1.89	57.13	0.81	609.47	8.65
Dec	47.99%	3328.04	399.35	5.70	132.97	1.90	54.80	0.78	587.12	8.38
Jan	48.61%	3510.82	426.74	6.01	132.97	1.87	56.75	0.80	616.47	8.69
Febr	48.40%	3482.34	421.47	5.96	132.97	1.88	56.69	0.80	611.13	8.65
Mar	48.81%	3366.43	410.94	5.77	132.97	1.87	57.03	0.80	600.94	8.43
April	47.78%	3545.34	423.58	6.07	132.97	1.91	56.88	0.82	613.43	8.79
May	48.19%	3541.05	426.74	6.07	132.97	1.89	56.69	0.81	616.40	8.76
June	47.74%	3530.25	421.47	6.05	132.97	1.91	57.01	0.82	611.45	8.77

6.14 Assumption Data-3

Name of Power Plant & Unit: Faridpur Peaking 54 MW Power Plant

Category of Technology: CC
Type of Fuel: F. Oil

For tariff calculation of Faridpur Peaking 54 MW Power Plant, the assumption data is given below –

Table No 6.19: Assumption Data-3

SL NO	Parameter/Assumption/Boundary Condition		Unit
1	Net Capacity of the Power Plant	54	MW
2	Project Cost (USD 845.15/kW)	3854.59	MTk
3	Exchange Rate	84.46	BDT/USD
4	Month Operation Hours	730	Hours
5	Calorific Value of F.Oil	36000	Kj/Liter
6	Fuel Price	54	Tk/Liter
7	Equity	30%	
8	Debt (70% of Total Rate Base)	70%	
9	Foreign/ECA Loan Facilities (60% of Total Debt)	60%	
10	Local/Commercial Loan facilities (40% of Total Debt)	40%	
11	Return on Equity	15%	
12	Rate of Interest of ECA Loan Facilities	12%	
13	Rate of Interest of Commercial Loan Facilities	12%	
14	Effective Plant Life	15	Years
15	Loan Repayment	10	Years
16	Salvage Value	5%	
17	Cash working capital	21.1667	MTk
18	Materials & Supplies		
19	Pre-payments	0.0249	MTk
20	Interest on regulatory working capital	15%	

6.15 Project Cost

Table No. 6.20: Project Cost

SL No	Item	Cost(10^6Tk)	Cost Tk	Share (%)
1	Intangible Plant	103.30	103303012	2.68%
2	Production Plant or Plant machinery and equipment			
2.1	Plant and machinery C&F,11/33 KV sub-station, Power Evacuation Line	3196.23	3196226028	82.92%
3	General Plant			
3.1	Land and Land Development	48.95	48953293	1.27%
3.2	Infrastructure (Building & Civil Works)	127.97	127972388	3.32%
3.3	Office Furniture and Equipment	3.85	3854590	0.10%
3.4	Laboratory Equipment	1.93	1927295	0.05%
3.5	Electric Equipment	1.93	1927295	0.05%
3.6	Transportation & Communication	26.21	26211212	0.68%
3.7	Miscellaneous Equipment	1.93	1927295	0.05%
3.8	Others tangible Equipment	1.93	1927295	0.05%
3.9	Interest During Construction	159.97	159965485	4.15%
3.1O	Contingencies	180.39	180394812	4.68%
4	**Total Project Cost (1+2+3)**	**3854.59**	**3854590000**	**100.0%**

6.16 Fixed Cost Calculation

6.16.1 Depreciation Calculation

Total project cost = $3854.9*10^6$ Tk
Salvage value = 5%
Plant life = 15 years

$$\text{Annual depreciation} = \frac{\text{Total Capital} - \text{Salvage Value}}{\text{Plant Life}}$$

$$= \frac{3854.9*10\text{^}6 - (14276.27*10\text{^}6*5\%)}{15}$$

$$= 244124033.3 \text{ TK}$$

$$\text{Monthly depreciation} = \frac{244124033.3}{12}$$

$$= 20343669.44 \text{ TK}$$

6.16.2 ECA Loan Calculation

Given that,

Loan/Debt amount is 70% of Used & Useful Asset = $3854.9*10^6 \times 0.70$

= 2697800000 Tk

60% of total debt amount that is ECA loan = 2697800000 × 0.60

= 1618680000 Tk

∴ Principal, P = 1618680000 Tk

Yearly interest rate, r = 12 %

Quarterly interest rate, (r/4) = 3 %

Number of installments, n = 40

We Know,

Principal = A×PVIFA

$$\Rightarrow 1618680000 = A \times \frac{1-\frac{1}{\left(1+\frac{r}{4}\right)^{n}}}{\frac{r}{4}}$$

$$\Rightarrow A = \frac{1618680000 \times \frac{r}{4}}{1-\frac{1}{\left(1+\frac{r}{4}\right)^{n}}}$$

$$\Rightarrow A = \frac{1618680000 \times \frac{12\%}{4}}{1-\frac{1}{\left(1+\frac{12\%}{4}\right)^{40}}}$$

$$\Rightarrow A = 70038666 \text{ TK}$$

∴ Every installment of ECA loan is 70038666 TK.

[Note: PVIFA – Present Value Interest Factor of Annuity]
This method shortly termed as Annuity method.

Definition of PVIFA:
A factor which can be used to calculate the present value of a series of annuities. The initial deposit, earning interest at the periodic rate (r), perfectly finances a series of (N) consecutive dollar withdrawals. PVIFA is also a variable used when calculating the present valued of an ordinary annuity.

Table No.6.21: ECA Loan Calculation

Quarters	Principal Beginning (Tk) (1)	Installment (Tk) (2)	Quarterly Interest (Tk) (3)=(1) x (.02)	Principal Repayment (Tk) (4)= (2) – (3)	Principal Ending (Tk) (5)= (1) – (4)	Yearly Interest (Tk)
1st	1618927800	70038666	48567834	21470832	1597456968	
2nd	1597456968	70038666	47923709	22114957	1575342011	
3rd	1575342011	70038666	47260260	22778406	1552563605	
4th	1552563605	70038666	46576908	23461758	1529101846	190328711
5th	1529101846	70038666	45873055	24165611	1504936236	
6th	1504936236	70038666	45148087	24890579	1480045656	
7th	1480045656	70038666	44401370	25637297	1454408360	
8th	1454408360	70038666	43632251	26406415	1428001944	179054763
9th	1428001944	70038666	42840058	27198608	1400803336	
10th	1400803336	70038666	42024100	28014566	1372788770	
11th	1372788770	70038666	41183663	28855003	1343933767	
12th	1343933767	70038666	40318013	29720653	1314213114	166365835

13th	1314213114	70038666	39426393	30612273	1283600841	
14th	1283600841	70038666	38508025	31530641	1252070200	
15th	1252070200	70038666	37562106	32476560	1219593640	
16th	1219593640	70038666	36587809	33450857	1186142783	152084334
17th	1186142783	70038666	35584283	34454383	1151688400	
18th	1151688400	70038666	34550652	35488014	1116200386	
19th	1116200386	70038666	33486012	36552655	1079647731	
20th	1079647731	70038666	32389432	37649234	1041998497	136010379
21st	1041998497	70038666	31259955	38778711	1003219785	
22nd	1003219785	70038666	30096594	39942073	963277712	
23rd	963277712	70038666	28898331	41140335	922137378	
24th	922137378	70038666	27664121	42374545	879762833	117919001
25th	879762833	70038666	26392885	43645781	836117051	
26th	836117051	70038666	25083512	44955155	791161897	
27th	791161897	70038666	23734857	46303809	744858087	
28th	744858087	70038666	22345743	47692924	697165164	97556996
29th	697165164	70038666	20914955	49123711	648041452	
30th	648041452	70038666	19441244	50597423	597444030	
31st	597444030	70038666	17923321	52115345	545328684	
32nd	545328684	70038666	16359861	53678806	491649879	74639380
33rd	491649879	70038666	14749496	55289170	436360709	
34th	436360709	70038666	13090821	56947845	379412864	
35th	379412864	70038666	11382386	58656280	320756583	
36th	320756583	70038666	9622697	60415969	260340614	48845401
37th	260340614	70038666	7810218	62228448	198112167	
38th	198112167	70038666	5943365	64095301	134016865	
39th	134016865	70038666	4020506	66018160	67998705	
40th	67998705	70038666	2039961	67998705	0	19814051

Return on ECA Loan per year (Sum of yearly interest rate/10) = 118261885 Tk

Return on ECA Loan per month (Return on loan per year/12) = 9855157.087 Tk

6.16.3 Commercial Loan Calculation

Given that,

Loan/Debt amount is 70% of Used & Useful Asset $= 3854.9*10^6 \times 0.70$

$= 2697800000$ Tk

40% of total debt amount that is ECA loan $= 2697800000 \times 0.40$

$= 1079120000$ Tk

∴ Principal, P = 1079120000 Tk

Yearly interest rate, r = 12%

Quarterly interest rate, (r/4) = 3%

Number of installments, n = 40

We Know,

$$\text{Principal} = A \times PVIFA$$

$$\Rightarrow 1079120000 = A \times \frac{1-\frac{1}{\left(1+\frac{r}{4}\right)^{n}}}{\frac{r}{4}}$$

$$\Rightarrow A = \frac{1079120000 \times \frac{r}{4}}{1-\frac{1}{\left(1+\frac{r}{4}\right)^{n}}}$$

$$\Rightarrow A = \frac{1079120000 \times \frac{12\%}{4}}{1-\frac{1}{\left(1+\frac{12\%}{4}\right)^{40}}}$$

$$\Rightarrow A = 46692444 \text{ TK}$$

∴ Every installment of commercial loan is 46692444 TK.

[Note: PVIFA – Present Value Interest Factor of Annuity]
This method shortly termed as Annuity method.

Definition of PVIFA:

A factor which can be used to calculate the present value of a series of annuities. The initial deposit, earning interest at the periodic rate (r), perfectly finances a series of (N) consecutive dollar withdrawals. PVIFA is also a variable used when calculating the present valued of an ordinary annuity.

Table No.6.22: Commercial Loan Calculation

Quarters	Principal Beginning (Tk) (1)	Installment (Tk) (2)	Quarterly Interest (Tk) (3)=(1) x (.03)	Principal Repayment (Tk) (4)= (2) – (3)	Principal Ending (Tk) (5)= (1) – (4)	Yearly Interest (Tk)
1st	1079285200	46692444	32378556	14313888	1064971312	
2nd	1064971312	46692444	31949139	14743305	1050228007	
3rd	1050228007	46692444	31506840	15185604	1035042403	
4th	1035042403	46692444	31051272	15641172	1019401231	126885808
5th	1019401231	46692444	30582037	16110407	1003290824	
6th	1003290824	46692444	30098725	16593719	986697104	
7th	986697104	46692444	29600913	17091531	969605573	
8th	969605573	46692444	29088167	17604277	952001296	119369842
9th	952001296	46692444	28560039	18132405	933868891	
10th	933868891	46692444	28016067	18676377	915192513	
11th	915192513	46692444	27455775	19236669	895955845	
12th	895955845	46692444	26878675	19813769	876142076	110910556
13th	876142076	46692444	26284262	20408182	855733894	
14th	855733894	46692444	25672017	21020427	834713467	
15th	834713467	46692444	25041404	21651040	813062426	
16th	813062426	46692444	24391873	22300571	790761855	101389556
17th	790761855	46692444	23722856	22969589	767792267	
18th	767792267	46692444	23033768	23658676	744133590	
19th	744133590	46692444	22324008	24368436	719765154	
20th	719765154	46692444	21592955	25099490	694665664	90673586
21st	694665664	46692444	20839970	25852474	668813190	
22nd	668813190	46692444	20064396	26628048	642185142	
23rd	642185142	46692444	19265554	27426890	614758252	
24th	614758252	46692444	18442748	28249697	586508555	78612667
25th	586508555	46692444	17595257	29097188	557411368	
26th	557411368	46692444	16722341	29970103	527441264	
27th	527441264	46692444	15823238	30869206	496572058	
28th	496572058	46692444	14897162	31795282	464776776	65037997

29th	464776776	46692444	13943303	32749141	432027635	
30th	432027635	46692444	12960829	33731615	398296020	
31st	398296020	46692444	11948881	34743564	363552456	
32nd	363552456	46692444	10906574	35785870	327766586	49759587
33rd	327766586	46692444	9832998	36859447	290907139	
34th	290907139	46692444	8727214	37965230	252941909	
35th	252941909	46692444	7588257	39104187	213837722	
36th	213837722	46692444	6415132	40277313	173560410	32563601
37th	173560410	46692444	5206812	41485632	132074778	
38th	132074778	46692444	3962243	42730201	89344577	
39th	89344577	46692444	2680337	44012107	45332470	
40th	45332470	46692444	1359974	45332470	0	13209367

Return on Commercial Loan per year (Sum of yearly interest rate/10) = 78841256.7 Tk

Return on Commercial Loan per month (Return on loan per year/12) = 6570104.725 Tk

6.16.4 Equity Calculation

Given that,

Equity amount is 30% of total rate base.

Since total rate base is $= 3854.9*10^6$ Tk

Therefore, Equity amount $= 3854.9*10^6 \times 0.30$

$= 1156377000$ TK

Principal, P = 1156377000 Tk

Return on equity rate, r = 15%

Effective plant life, n = 15 years

We Know,

Principal = A×PVIFA

$$\Rightarrow 1156377000 = A \times \frac{1-\frac{1}{(1+r)^n}}{\frac{r}{4}}$$

$$\Rightarrow A = \frac{1156377000 \times r}{1-\frac{1}{(1+r)^n}}$$

$$\Rightarrow A = \frac{1156377000 \times 15\%}{1-\frac{1}{(1+15\%)^{15}}}$$

$\Rightarrow$ A = 197760186 TK

[Note: PVIFA – Present Value Interest Factor of Annuity]
This method shortly termed as Annuity method.

Definition of PVIFA:
A factor which can be used to calculate the present value of a series of annuities. The initial deposit, earning interest at the periodic rate (r), perfectly finances a series of (N) consecutive

dollar withdrawals. PVIFA is also a variable used when calculating the present valued of an ordinary annuity.

Table No. 6.23: Equity Calculation

Quarters	Principal Beginning (Tk) (1)	Installment (Tk) (2)	Yearly Interest (Tk) (3)= (1) x (0.15)	Principal Repayment (Tk) (4)= (2) – (3)	Principal Ending (Tk) (5)= (1) – (4)
1st	1156377000	197760186	173456550	24303636	1132073364
2nd	1132073364	197760186	169811005	27949182	1104124182
3rd	1104124182	197760186	165618627	32141559	1071982623
4th	1071982623	197760186	160797393	36962793	1035019830
5th	1035019830	197760186	155252975	42507212	992512618
6th	992512618	197760186	148876893	48883294	943629325
7th	943629325	197760186	141544399	56215788	887413537
8th	887413537	197760186	133112031	64648156	822765382
9th	822765382	197760186	123414807	74345379	748420003
10th	748420003	197760186	112263000	85497186	662922817
11th	662922817	197760186	99438422	98321764	564601053
12th	564601053	197760186	84690158	113070028	451531024
13th	451531024	197760186	67729654	130030533	321500492
14th	321500492	197760186	48225074	149535113	171965379
15th	171965379	197760186	25794807	171965379	0

Return on Equity per year (Sum of yearly interest rate/15) = 120668386 Tk

Return on Equity per month (Return on Equity per year/12) = 10055698.9 Tk

6.17 Total Fixed Cost & Per Unit Fixed Cost

Table No.6.24: Total Fixed Cost

Item	Monthly	Yearly
Depreciation expense (Tk)	20343669.44	244124033.3
ECA Loan (Tk)	9855157.087	118261885
Commercial Loan (Tk)	6570104.725	78841256.7
Return on equity (Tk)	10055698.86	120668386.3
Return on Regulatory Working Capital	264894.2143	3178730.572
Total amount (Tk)	**47089524.33**	**565074291.9**
Total amount (MTk)	**47.08952433**	**565.0742919**

Table No.6.25: Power production Statement

Month	Fuel Consumption (MLiter)	Electricity Generation (MKWh)	Operating Capacity (MW)
JULY	2.77	11.87	54
AUG	2.73	11.87	54
SEPT	2.75	11.25	54
OCT	2.73	11.15	54
NOV	2.75	11.36	54
DEC	2.73	11.47	54
JAN	2.76	11.62	54
FEB	2.76	13.15	54
MAR	2.77	12.31	54
APRIL	2.72	11.19	54
MAY	2.74	11.89	54
JUNE	2.78	10.87	54

$$\text{Per unit fixed cost (yearly)} = \frac{\text{Total Amount of Fixed Cost}}{\text{Generated Electricity}}$$

$$= \frac{\mathbf{565.0742919}}{\mathbf{140}} \textbf{ TK/KWh}$$

$$= 4.0362 \textbf{ TK/KWh}$$

6.18 Variable Cost Calculation

6.18.1 Fuel Cost Calculation (July)

Operating capacity = 54 MW

Generated electricity = 11.87 MKWh

Calorific Value of Coal = 36000 KJ/Liter

Fuel Price = 54 Tk/Liter

Fuel consumption = 2.77 MLiter

Hours in current month = 730 hours

$$Plant\ Factor = \frac{\text{Generated Electricity in KWh}}{\text{Operating Capacity} \times 1000 \times \text{Hours in Current Month}} \times 100\%$$

$$= \frac{11.87 \times 10^6}{54 \times 1000 \times 730} \times 100\%$$

$$= 30.11\ \%$$

$$Heat\ Rate = \frac{\text{Calorific Value of Fuel} \times \text{Fuel Consumtion}}{\text{Generated Electricity}}$$

$$= \frac{36000 \times 1000 \times 2.77}{11.87}$$

$$= 2011.96\ (KJ/KWh)$$

Total fuel cost = Fuel price × Fuel consumtion

= 54 Tk/Liter × 2.77 MLiter

= ***149.73 MTk***

$$\text{Fuel cost per unit energy} = \frac{\text{Total Fuel Cost}}{\text{Generated Electricity}}$$

$$= \frac{149.73}{11.87}$$

$$= 12.61\ Tk/KWh$$

6.18.2 Non-Fuel or Operation & Maintenance Cost Calculation(July)

Table No. 6.26: Components for Non-Fuel Cost (MTk)

Month	Total Personnel Exp. (MTK)	Office Expenses (MTK)	Exchange Rate Fluctuation (MTK)	Assets Insurance	Fund General & Administrative Exp. (MTK)	VOMP (MTK)	Total Non-Fuel Cost (MTK)	Total Non-Fuel Cost (TK)
JULY	2.21	0.13	4.12	0.02	2.59	1.59	10.66	10661437.32
AUG	2.20	0.13	4.11	0.02	2.58	1.58	10.62	10619400.47
SEPT	2.18	0.12	4.08	0.02	2.56	1.57	10.54	10540062.86
OCT	2.14	0.12	4.00	0.02	2.51	1.54	10.33	10327508.81
NOV	2.21	0.13	4.14	0.02	2.60	1.59	10.70	10702882.59
DEC	2.12	0.12	3.97	0.02	2.49	1.53	10.26	10264749.3

JAN	2.20	0.13	4.11	0.02	2.58	1.58	10.63	10631834.05
FEB	2.20	0.13	4.11	0.02	2.58	1.58	10.62	10619400.47
MAR	2.21	0.13	4.14	0.02	2.59	1.59	10.68	10682159.96
APRIL	2.20	0.13	4.12	0.02	2.59	1.59	10.65	10653148.28
MAY	2.20	0.13	4.11	0.02	2.58	1.58	10.62	10619400.47
JUNE	2.21	0.13	4.13	0.02	2.59	1.59	10.68	10678015.44
TOTAL	**26.27**	**1.52**	**49.15**	**0.30**	**30.85**	**18.91**	**127.00**	**127000000**

Generated Electricity = 11.87 MKwh

Total Non-Fuel or Operation & Maintenance Cost = 10.66 MTk

Per unit Non-Fuel or O & M Cost = $\frac{Non-Fuel\ Cost\ (MTk)}{Generated\ Electricity(MKwh)}$

$= \frac{10.66\ MTk}{11.87\ MKwh}$

= 0.898 Tk/Kwh

6.19 Chart of Cost

Table No.6.27: Chart of Cost

Month	Plant Factor %	Heat Rate (KCal/ Kwh)	Total Fuel Cost (MTk)	Per Unit Fuel Cost (TK/Kwh)	Fixed Cost (MTk)	Per Unit Fixed Cost (Tk/Kwh)	Non-Fuel or O & M Cost (MTk)	Per Unit Non-Fuel or O & M Cost (Tk/KWH)	Total Cost (MTk)	Per Unit Total Cost (Tk/Kwh)
July	30.11%	2011.96	149.73	12.61	47.09	3.97	10.66	0.90	207.48	17.48
Aug	30.11%	1981.48	147.46	12.42	47.09	3.97	10.62	0.89	205.17	17.29
Sept	28.54%	2106.30	148.59	13.21	47.09	4.19	10.54	0.94	206.22	18.33
Oct	28.27%	2113.40	147.69	13.25	47.09	4.23	10.33	0.93	205.10	18.40
Nov	28.83%	2082.47	148.37	13.06	47.09	4.14	10.70	0.94	206.16	18.14
Dec	29.11%	2046.50	147.23	12.83	47.09	4.10	10.26	0.89	204.59	17.83

Jan	29.48%	2045.56	149.05	12.83	47.09	4.05	10.63	0.91	206.77	17.79
Feb	33.36%	1810.53	149.28	11.35	47.09	3.58	10.62	0.81	206.98	15.74
Mar	31.23%	1937.05	149.50	12.15	47.09	3.83	10.68	0.87	207.27	16.84
April	28.38%	2096.05	147.01	13.14	47.09	4.21	10.65	0.95	204.75	18.30
May	30.16%	1987.23	148.14	12.46	47.09	3.96	10.62	0.89	205.85	17.31
June	27.58%	2199.81	149.96	13.79	47.09	4.33	10.68	0.98	207.72	19.11

6.20 Tariff Rate

This is for information of all concerned that in accordance with the BERC) published in the energy rate, dated: 23 November 2017, the new tariff rates with respect to retail sales of electricity of Dhaka Electric Supply Company Ltd. (DESCO) has been made effective from bill month November 2017 as the followings [17]

Table – 6.28: Tariff Rate

SL		Customer Category	Per Unit Rate (Tk.)
1		**Category-A: Residential**	
	a	First Step: From 000 to 100 units	2.6
	b	Second Step: From 101 to 400 units	3.3
	c	Third Step: From 401 to above	5.65
2		**Category-B: Agricultural pumping**	1.93
3	a	**Category-C: Small Industries**	
	b	Flat Rate 4.35	4.35
	c	Off-Peak Time	3.5
		Peak Time	5.95
4		**Category-D: Non-Residential (Light & Power)**	
5		**Category-E: Commercial**	
	a	Flat Rate	5.58

	b	Off-Peak Time	4.05
	c	Peak Time	8.45
6	**Category-F: Medium Voltage, General Purpose (11 KV)**		
	a	Flat Rate	4.17
	b	Off-Peak Time	3.43
	c	Peak Time	7.12
7	**Category-G-1: Extra High Voltage (DESCO 132 KV)**		2.12
8	**Category-G-2: Extra High Voltage, General Purpose (132 KV)**		
	a	From 23:00 to 06:00	1.49
	b	From 06:00 to 13:00	2.48
	c	From 13:00 to 17:00	1.66
	d	From 17:00 to 23:00	5.52
	e	Flat Rate	2.82
9	**Category-H: High Voltage, General Purpose (33 KV)**		
	a	Flat Rate	3.92
	b	Off-Peak Time	3.33
	c	Peak Time	6.82
10	**Category-I: Rural Electrification Board (33 KV)**		
	a	DESCO to REB	2.12
11	**Category-J: Street Light and Water Pumps**		3.98

6.20 Bill Explanation

✍ ***What all utility bills should contain?***

Bills – for electricity – should always be dated and contain the following information (Usually on the first page of the bill) –

- Your Name and Address.
- Your customer account or reference number (Always quote this when you

contact your supplier).

- The name of your supplier and its contact details.
- How much you need to pay (Including any money owed from previous bills) and when you need to pay by.

✍ ***More Detailed Information -***

The following more detailed information about the amount of energy you've used is often found on a separate page of the bill –

- Billing Period – The period in which you used the energy you're being charged for.
- Meter Readings – The difference between the previous and latest reading is the amount of energy (Measured in Kilowatt Hours or KWh) you've used.
- The amount your supplier is charging you for each KWh of electricity. If you pay a standing charge (Which covers things like meter readings and the cost of keeping you connected to the network) you'll pay a single rate; if not then you will pay a higher price for a given number of units and then a lower rate thereafter.
- Meter Number – If your supplier has changed your meter during the billing period you'll see readings for two different meter numbers. [18]

CHAPTER 7

CONCLUSION

7.1 Conclusion

Electricity generation tariff is an important issue of our country. Because electricity tariff rate depends on electricity generation tariff rate and is related with our economic growth. When electricity tariff rate becomes high then poor people of our country suffers a lot. By thinking about them, electricity tariff rate of our country should be low. If we use natural gas as a fuel then we can reduce fuel cost of generation. Al-though natural gas is insufficient in our country. So, we should make public awareness about misuse of our natural gas. Our government should take step for improvement our power station. In our power station, generators efficiency rate is low. It should be increased to a high value by taking necessary steps.

On the other hand, electricity plays vital role in the socio-economic development and poverty reduction. Presently 90% (in 2018) of the total population has access to electricity and per capita generation is only 372 KWh (in 2014), which are very low compared to other developing countries. The Government has given highest priority to power sector development in Bangladesh and is committed to making electricity available to all citizens by 2021. In this connection, the Government has initiated implementing reform measures in the power sector, including significant development programs of which this Project constitutes an important part.

After all, at present Bangladesh power sector is in loss crisis. On a consolidated basis the losses from inadequate end-use customer tariffs are compensated from profits in the generation and transmission segment of the power sector. However, inadequate tariffs will, in the first place affect the distribution segment and lead there to a similar situation than the one prevailing today despite all efforts to improve efficiency and performance, the distribution companies will not be in the position to collect sufficient money to pay for their operating expenses and their debt service

In consequence the upstream segments of the power sector (Generation and Distribution) will not receive sufficient money; which in turn will lead to a continuation of the maintenance backlog in the generation segment and even worse in delays in the financing of important investment in the enhancement and improvement of the system.

Improvement of the quality of power supply to end-use customer needs to be achieved fast to improve acceptance of tariff increases. Performance and efficiency improvements on the other hand will require significant investment in the first place in power generation capacity and in consequence in the downstream transmission and distribution equipment. The projections assume that investment of TK 165.9 billion (US$ 2.4 billion) will be required for rehabilitation of existing and installation of new power generation capacity in the coming four years. In addition to that some TK 50 billion (US$ 0.7 billion) will have to invested in the expansion of the transmission system and TK 77.8 billion (US$ 1.1 million) in the rehabilitation, enhancement and expansion of the distribution system.

It is finally a decision to be taken by the Government to what extent a tariff increase can be enforced in Bangladesh given the present quality of supply. The financial projections show that even a gradual increase of tariffs with the objective to achieve full cost recovery in 2021 will create serious problems in the distribution companies, which could – in consequence – result in a similar situation that the power sector is facing today.

7.2 Limitations of the Work

There are few limitations I have faced are mentioned below -

- In this study the data of power plants I have used are collected from BERC (Bangladesh Energy Regulatory Commission) but some of these data are assumption.
- The generating cost of power plants I have calculated are almost the same as that given by BERC. The slight difference of cost caused by the data that are assumption.
- In this thesis, I have discussed about electricity generation structure and calculated the generating cost of several power plants. But the tariff rate of electric power depends on both generating cost and transmission distribution cost. To calculate the tariff rate of electric power, transmission and distribution cost needs to be calculated along with the generation cost.

7.3 Future Scopes of the Work

Normally, Tariff rate of electrical power depends on generating price and transmission cost. If generating price and transmission cost are high then electrical tariff rate can high and vice-versa. In this paper, I even have mentioned concerning generating price, a way to calculate generating price with example. I even have additionally mentioned concerning the necessary terms that is chargeable for high generating price. Anyone will work to calculate the transmission and cost. Interested folks will study to calculate the generating price for a high capability electrical power plant. And can also study to calculate the transmission and cost. If anyone will calculate the transmission and cost then he/she can ready to calculate the tariff rates.

REFERENCES

[1] https://en.wikipedia.org/wiki/Electricity_sector_in_Bangladesh, July 2018.

[2] V.K. Mehta & Rohit Mehta, *Principles of Power System* , 4th Revised Edition, S. Chand & Company Ltd. http://www.bpdb.gov.bd/bpdb_new/index.php/site/daily_generation_report, 11 September, 2018.

[3] http://en.wikipedia.org/wiki/Electricity_sector_in_Bangladesh, retrieved on 05 December, 2018.

[4] http://www.powerdivision.gov.bd, retrieved on 06 December, 2015.

[5] https://en.wikipedia.org/wiki/Electricity_generation, retrieved on 07July, 2018.

[6] Electricity Generation Tariff Methodology from BERC.

[7] https://energypedia.info/wiki/Bangladesh_Energy_Situation#Electricity, retrieved on 08 December, 2015.

[8] http://www.investopedia.com/terms/i/intangibleasset.asp, retrieved on 09 December, 2015.

[9] http://seattlecentral.edu/faculty/moneil/A220/L10/Horngren10.htm, retrieved on 09 December, 2015.

[10] https://courses.candelalearning.com/acct/chapter/depreciation-of-plant-assets/, retrieved on 11 December, 2015.

[11] https://en.wikipedia.org/wiki/Loan, retrieved on 11 December, 2015.

[12] http://www.investopedia.com/terms/e/export-credit-agency.asp, retrieved on 14 December, 2015.

[13] http://www.investopedia.com/terms/c/commercial-loan.asp, retrieved on 14 December, 2015.

[14] http://www.businessdictionary.com/definition/commercial-loan.html, retrieved on 18 December, 2015.

[15] https://en.wikipedia.org/wiki/Equity_%28finance%29, retrieved on 18 December, 2015.

[16] http://www.nei.org/Knowledge-Center/Nuclear-Statistics/Costs-Fuel,-Operation,-Waste-Disposal-Life-Cycle, retrieved on 24 April, 2016.

[17] https://www.desco.org.bd/?page=tariff-rate-2, retrieved on 27 November, 2017.

[18] http://www.powerdivision.gov.bd, retrieved on 20 December, 2016.