DAFFODIL INTERNATIONAL UNIVERSITY

THESIS PAPER

ON

"STUDY OF ELECTRICITY GENERATION COST DETERMINATION"

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APPROVAL

This thesis titled **"STUDY OF ELECTRICITY GENERATION COST DETERMINATION",** submitted by Rabiul Hasan & Tareq Hasnat 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.

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DECLARATION

We hereby declare that, this thesis has been done by us under the supervision of **Dr.M.Shamsul Alam** .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.

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Finally, we must acknowledge with due respect the constant support and patients of our parents.

ABSTRACT

The topics of the thesis is on **"STUDY OF ELECTRICITY GENERATION COST DETERMINATION",** the tariff construction would comprise of two parts. In the process of bids, the bidders shall offer mass power tariff based on the capacity payment and energy payment that provide the equivalent equity tariff. The capacity payment will be issued in Bangladeshi currency (Taka). This will cover outstanding payment service, return on equity, fixed operation and preservation cost, insurance and other fixed cost. The energy remission will be designated in local currency to the area to which the variable costs are in local currency. Including fuel, this will cover the variable costs of operation and maintenance. The power will be obtained from the IPP at an identified voltage and frequency at the outgoing terminal of the substation of the power plant. The cost of interconnecting avail to outgoing stations of the private power project will be generated by the private power producers. On the other hand, severe power crisis urged the Government to enter into contractual agreements for high-cost temporary solution, such as hire charge power and small IPPs, on an emergency basis, much of it diesel or liquid-fuel based. This has obtruded an immense fiscal pressure. With a power division which is almost rely on natural- gas fired generation (89.22%), the country is challenge a concurrent shortage of natural gas and electricity. Due to shortage of gas supply, nearly 400-800 MW of power could not be of advantage to from the power plants. Government has no option but to go for fuel diversity option for power generation but other fuels for generating low-cost, base-load energy, such as coal or renewable source like hydropower are not readily available.

KEYWORDS-Generating cost, Construction, Preservation Cost, Substation, Interconnecting, and Diversity.

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CHAPTER 1
INTRODUCTION

1.1: Introduction

Power is considered as the blood of modern world. It plays a vital role in industry, agriculture, and transportation etc. The living standard and prosperity of a nation vary directly with increase with the development of the power sector. As technology is advancing with the invention of modern science the consumption of power is steadily rising.

Sufficient and reliable source of electricity is a major precondition for a sustained and successful economic growth effort and poverty reduction. In Bangladesh, 16.6 million of the populations out of 166 million do not have direct access to electricity and remaining 149.4 million people have access but reliable and constant power supply is still beyond their reach (BPDB, 2018). In order to increase the growth rate, availability of a reasonably priced and reliable source of electricity is a prerequisite. Present generation of electric power in Bangladesh is not sufficient to meet the consumers with the growing demand. So it is not possible to ensure a constant supply of electric power to all consumers throughout the country. Moreover the demand fowl power is increasing day by day. So it is essential to set up more power plants to meet the growing demand. On the other hand, the existing power stations have lost production ability; they are not reliable for steady generation. So it has to be replaced old generating units with new power stations. Shortage of power is causing serious problem and strong barrier for the development of our country. Government of Bangladesh is facing many restrictions to set up sufficient power station. The government has given top priority for the development of this sector considering its importance in overall development of the country. The government has set the goal of providing electricity to all citizens by 2020. (Ref. www.bpdb.gov.bd)

Bangladesh's energy infrastructure is quite small, insufficient and poorly managed. The per capita energy consumption in Bangladesh is one of the lowest (433 kWh) in the world. Non-commercial energy sources, such as wood, fuel, animal waste, and crop residues, are estimated to account for over half of the country's energy consumption. Bangladesh has small reserves of oil and coal, but very large natural gas resources. Commercial energy consumption is mostly natural gas (around 64.99%), followed by oil, hydropower and coal.

Electricity is the main basis of power for the development of the country's economic activities.

Bangladesh's installed electric generation capacity was 20,133MW in September 2018[2] only three-fourth of which is considered to be available. Only 90% of the population has access to electricity with a per capita availability of 433 kWh per annum. The main problems in the Bangladesh's power sector is corruption in administration, high system losses, and delays in completion of new plants, low efficiencies, erratic power supply, electricity theft, blackouts, Bangladesh's energy infrastructure is quite small, insufficient and poorly managed. The per capita energy consumption in Bangladesh is one of the lowest (433 kWh) in the world. Non-commercial energy sources, such as wood fuel, animal waste, and crop residues, are estimated to account for over half of the country's energy consumption. Bangladesh has small reserves of oil and coal, but very large natural gas resources. Commercial energy consumption is mostly natural gas (around 64.99%), followed by oil, hydropower and coal.
Electricity is the major source of power for most of the country's economic activities.

(Ref. http://en.wikipedia.org/wiki/Electricity_sector_in_Bangladesh)

1.2: Electricity Generation Structure

Bangladesh Power Development Board (BPDB), Ashuganj Power Station Company Limited (APSCL), Electricity Generation Company of Bangladesh (EGCB) is producing electricity for the public sector. 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 high rate. Besides that big industries produce 1200 MW electricity for their own use from which additional 88 MW is supplied to the national grid. Presently nearly 56 percent of total electricity production is produced from public entities. BPDB alone produces 46 percent of total electricity production.

(Ref. http://www.powerdivision.gov.bd)

1.3: Use of different types of energy:

Natural Gas is used as primary energy resource for the most of the present power plants. 66.44 percent of total electricity is produced from gas-based power plants. Besides gas, a small amount of electricity is produced using diesel, furnace oil and coal. In addition, almost 3 percent of total electricity is produced from Karnafuly Hydro Power Plant. Due to the growth of multiple use of gas in fertilizer, industries, factories and other sectors it is not possible to supply adequate quantity gas (extracted from the existing gas fields) to meet the demand of the power

plants. Due to inadequacy of gas supply at present approximately 500MW less electricity is produced from existing power plants.

(Ref. http://www.powerdivision.gov.bd)

From the above discussion it is obvious that in the power sector the following subjects 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.
- 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 Plan of the Government and the Work Plan framed in according to the Perspective Plan towards modification of the above stated problems are argued in 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 2013 - 8500 MW
- Electricity Generation in the country by 2015-11,500 MW
- Electricity Generation in the country by 2021 - 20,000 MW
- Electricity for all by 2021

There is a planning of the Government achieving the following objectives for creating 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 LNG), coal and oil as the primary fuels for electricity generation;
- 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; and
- Reduction of system loss.
- Importation of LNG

(Ref. http://www.powerdivision.gov.com)

To address the issues the following constraints, possibilities and strategies are identified:

Constraints

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

Possibilities

- Coal-based power plants using domestic and imported coal;
- Rooppur Nuclear Power Plant;
- Availability of new gas both offshore and onshore;
- Public-Private Partnership Projects;
- Prospect pf participation of local investors in the sector.
- Medium-term agreement to import LNG and steps to be taken

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 IPP;
- To increase sector efficiency, reform measures must be implemented.(Ref. http://www.powerdivision.gov.bd)

1.5: Objective:

The main objective of this thesis is to calculate the production cost of an electric power station that is tariff calculation. The main objective is that, we will learn about tariff, how to calculate production cost of an electric power station. This thesis will help to find the parameters which are caused to maximize the generating cost. To do this, we have to calculate the fuel cost of generation. Low cost fuel should be used like natural gas. Then we will calculate service charge/cost. By adding these two costs (fuel cost and service cost), we will get the total generating cost .Then we will note the parameters that which are mostly affect the generating cost. Consequently, we can easily minimize the generating cost by taking necessary steps.

1.6: Thesis diagram

The study of this thesis 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 the 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 a document, approved by the Commission, listing the terms and conditions of service and a schedule of rates, under which licensee services will be provided.

2.2: Electricity tariff:

Electricity tariff (sometimes denoted to as electricity pricing or the price of electricity) varies broadly from country to country, and may differ meaningfully from locality to locality within a specific country. There are many causes that account for these variances in price. The price of power generation depends largely on the type and market price of the fuel used, government subsidies, government and industry regulation, and even local weather patterns. (Ref. http://en.wikipedia.org/wiki/Electricity_sector_in_Bangladesh)

2.3: Basis of electricity rates:

Electricity prices differ country to country and can even contrast within a single region or distribution network of the same country. In standard regulated monopoly markets, electricity rates typically differ for residential, commercial, and industrial customers. Prices for any single class of electricity consumer can also vary by time-of-day or by the capacity or nature of the amount 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 detailed 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). (Ref. http://en.wikipedia.org/wiki/Electricity_sector_in_Bangladesh)

2.4: Electricity generation:

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

The essential principles of electricity generation were discovered during the 1820s and early 1830s by the British scientist Michael Faraday. His basic method is still using today: **electricity is produced by the movement of a loop of wire, or disc of copper between the poles of a magnet.** For electric utilities, **it** is the first process in the delivery of electricity to consumers. The other processes, electricity transmission, distribution, and electrical power storage and recovery using pumped-storage methods are normally carried out by the electric power industry. Electricity is most often generated at a power station by electromechanical generators, primarily driven by heat engines fuelled by chemical combustion or nuclear fission but also by other means such as the dynamic energy of flowing water and wind. Other energy sources include solar photovoltaic and geothermal power.

(Ref. http://en.wikipedia.org/wiki/Electricity_sector_in_Bangladesh)

2.5: Electricity generation in Bangladesh:

Different types of power plants produce electricity and synchronize it with the national grid. There are some isolated diesel power stations at distant places and islands which are not attached with the National Grid. Terminal voltages of different generators are 11 KV, 11.5 KV and 15.75 KV.

In the Eastern Zone (eastern side of river Jamuna), electricity is produced from indigenous gas and a small percentage through hydro power. In the Western Zone, Coal and imported liquid fuel is used for generation of electricity. The fuel cost per unit generation in the Western Zone is much higher than that of the Eastern Zone. Therefore, as a policy, low cost electricity generated in the Eastern Zone is transferred to the Western Zone through the 230 kV East-West Inter connector transmission line.

(Ref. http://en.wikipedia.org/wiki/Electricity_sector_in_Bangladesh

2.6: Important terms for Calculation:

Accessibility Factor: means the ratio of (a) the number of hours a producing 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% directs prearranged or unplanned outages for maintenance. A plants availability factor will be higher than its capacity factor, because a plant is not used in every hour it is available.

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

Commission: 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 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): means a measure of electricity defined as a unit of work or energy, measured as 1 kilowatt (1,000 watts) of power expended for an 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: 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: 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.(Ref. Electric generation Tariff methodology from BERC)

2.7: Electricity Situation at a glance:

Table No-2.1

Electricity Situation at a Glance	
Generation Capacity	**20,133 MW**
Maximum Generation(19-09-2018)	**11,623 MW**
Transmission Lines(400 kV)	**698 Ckt.km**
Transmission Lines(230 kV)	**3343 Ckt.km**
Transmission Lines(132 kV)	**7082 Ckt.km**
Number of Clients	**3,11,00000**
Transmission and distribution losses	**12.19%**
Distribution line	**4,71,000 km**
Per capita generation	**464 kWh**
Access to electricity	**90%**

Electricity Situation at a Glance

Table No-2.2

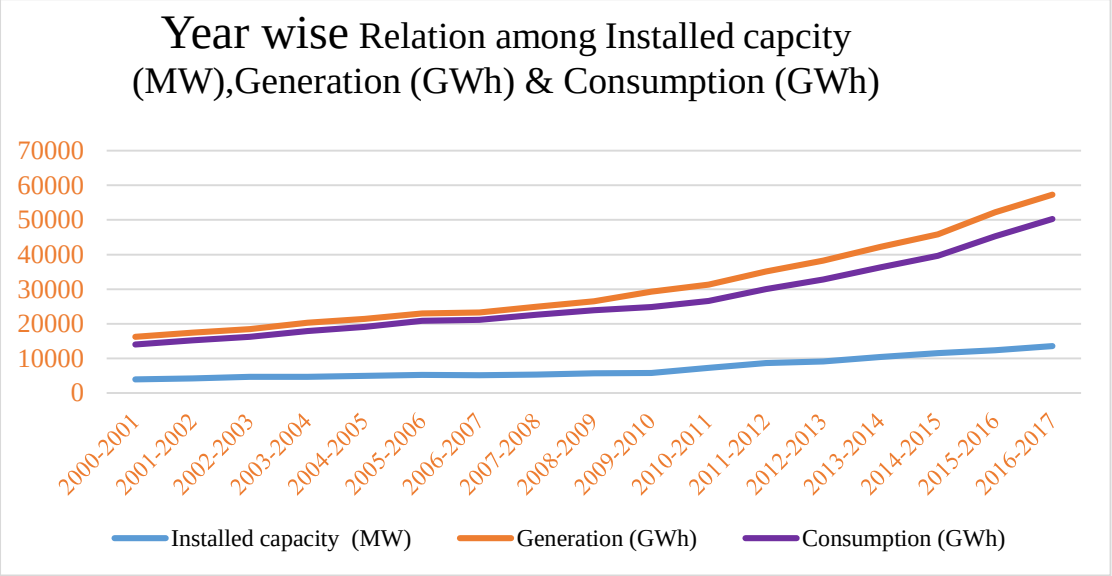

Figure 2.1: Electricity Generation, Consumption & Installed Capacity of Bangladesh

Table No-2.3

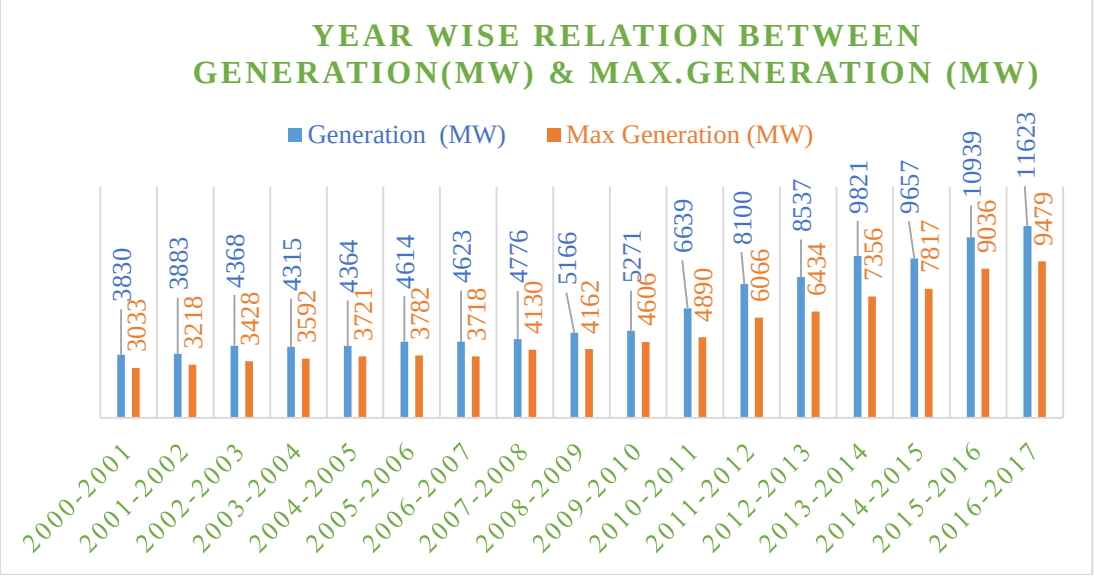

Figure 2.2: Year-wise Electricity Generation

CHAPTER 3
THE COST OF THE PROJECT

3.1: Used and Useful Assets

In making application for a tariff rate or a change in the tariff's terms and conditions, the electric generation licensee must file a schedule which shows the original acquisition cost of the asset, the accumulated depreciation, the net asset value after reduction for accumulated depreciation, and the amount of the current depreciation to be included in the Tariff Rate application for the test year.
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: Plant of Intangible

An intangible asset can be classified as either indefinite or definite depending on the specifics of that asset. An asset that is not physical in nature. Corporate intellectual property items such as patents, trademarks, copyrights, business methodologies, and goodwill and brand recognition are all common intangible assets in today's marketplace. A company brand name is considered to be an indefinite asset, as it stays with the company as long as the company continues operations. However, if a company enters a legal agreement to operate under another company's patent, with no plans of extending the agreement, it would have a limited life and would be classified as a definite asset.

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.

3.3: Plant of Production

Production plant would include land and land rights, structures and improvements, accessory electric equipment and miscellaneous power plant equipment. Steam production plants would additionally include boiler plant equipment, engines and engine driven generators and turbo generator units. Hydroelectric plant would further include reservoirs, dams and waterways, water wheels, turbines and generators, roads, railroads and bridges. Solar thermal production units would as well include concentrating collectors, solar radiation monitoring equipment, engines and engine driven generators and turbo generator units. Solar photovoltaic production units would include the photovoltaic panels, mounting racks, solar radiation monitoring equipment, balance of system equipment and energy storage devices. Wind production units would include the wind-powered generators, towers, wind monitoring equipment and balance of system equipment. Other production would further include fuel holders, producers and accessories, prime movers and generators.

3.4: Plant in General

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.

CHAPTER 4
FIXED COST

4.1: Depreciation

The amount of depreciation included as a cost is the total annual depreciation for all used and useful assets for the test year. The amount of the current depreciation will be added as an expense in total costs at the current book value of the assets and is not subject to re-evaluation based upon any subsequent revision of the asset valuation. Companies record depreciation on all plant assets except land. Since the amount of depreciation may be relatively large, depreciation expense is often a significant factor in determining net income. For this reason, most financial statement users are interested in the amount of, and the methods used to compute, a company's depreciation expense. Depreciation is the amount of plant asset cost allocated to each accounting period benefiting from the plant asset's use. Depreciation is a process of allocation, not valuation. Eventually, all assets except land wear out or become so inadequate or outmoded that they are sold or discarded; therefore, firms must record depreciation on every plant asset except land. They record depreciation even when the market value of a plant asset temporarily rises above its original cost because eventually the asset is no longer useful to its current owner.

4.2: Loan

In finance, a loan is a debt provided by an entity (Organization or Individual) to another entity at an interest rate, and evidenced by a note which specifies, among other things, the principal amount, interest rate and date of repayment. A loan entails the reallocation of the subject asset(s) for a period of time, between the lender and the borrower. In a loan, the borrower initially receives or borrows an amount of money, called the principal, from the lender and is obligated to pay back or repay an equal amount of money to the lender at a later time.

The loan is generally provided at a cost, referred to as interest on the debt, which provides an incentive for the lender to engage in the loan. In a legal loan, each of these obligations and restrictions is enforced by contract, which can also place the borrower under additional restrictions known as loan covenants. Although this article focuses on monetary loans, in practice any material object might be lent.

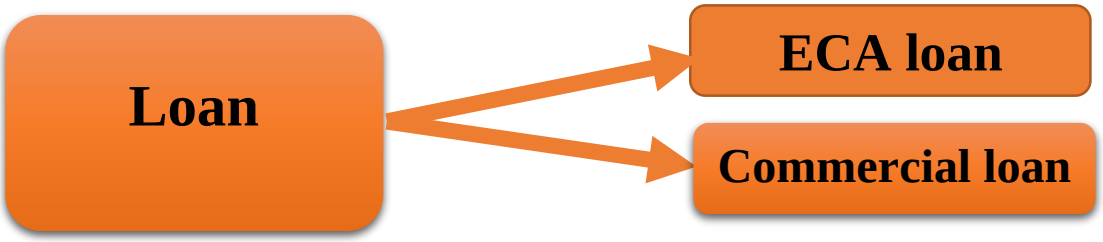

Figure 4.1: Types of Loan.

4.3: Export Credit Agency (ECA) Loan

A financial institution or agency that provides trade financing to domestic companies for their international activities and Export credit agencies (ECAs) provide financing services such as guarantees, loans and insurance to these companies in order to promote exports in the domestic country. The primary objective of ECAs is to remove the risk and uncertainty of payments to exporters when exporting outside their country. ECAs take the risk away from the exporter and shift it to themselves, for a premium. ECAs also underwrite the commercial and political risks of investments in overseas markets that are typically deemed to be high risk.

4.4: Commercial Loan

A debt-based funding arrangement that a business can set up with a financial institution. The proceeds of commercial loans may be used to fund large capital expenditures and/or operations that a business may otherwise be unable to afford.

Loan advanced to a business instead of to a consumer. Commercial loans are usually for a short-term, secured (Backed by a Collateral) or unsecured, and are often advanced for financing equipment, machinery, or inventory. Banks usually require the commercial borrowers to submit monthly and annual financial statements, and to maintain insurance cover on the financed item.

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).

4.6: Equity Return on

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 determining the return on equity is a form of a capital asset pricing model (CAPM). It assumes that the cost of equity is the sum of a risk-free rate of return, plus a return to compensate investors for market risk. It is the responsibility of the licensee applying for a tariff rate change to recommend a rate of return on equity and provide 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.

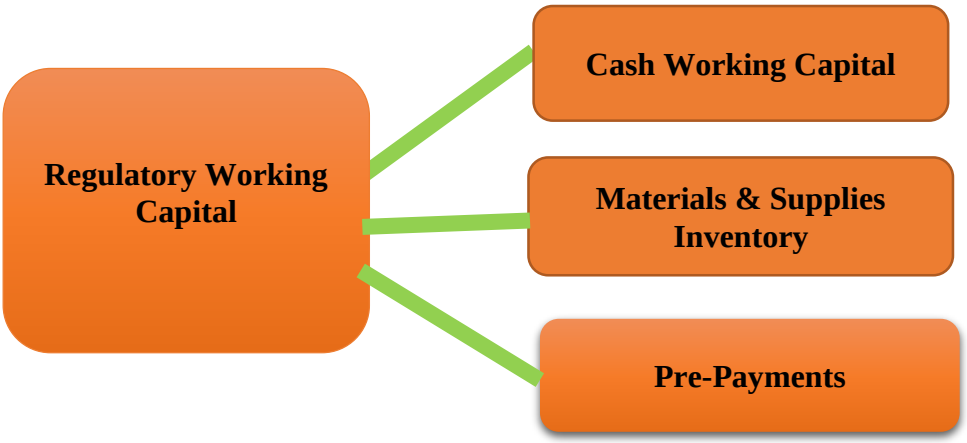

Figure 4.2: Parts of Regulatory Working Capital.

4.8: Capital on Cash Working

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

$$\textbf{Cash Working Capital} = \frac{\textbf{Annual Opertaion \& Maintaenance Cost}}{\textbf{6}}$$

4.9: Inventory on Materials & Supplies

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.

$$\textit{Materials \& Supplies Inventory} = \frac{\textit{Total of 12 Month Value Materials \& Supplies}}{12}$$

4.10: Pre-payments

Pre-payments are made in advance of the period to which they apply and include items such as pre-paid rents, insurance and taxes. The amounts normally allowed are based on the same standards outlined above for Materials & Supplies Inventories. The average monthly measurement period should encompass more than a single test year review, since certain pre-paid expenses (Such as pre-paid insurance) often are made for periods in excess of one year. Sum the pre-paid balances over whatever the longest cycle of any individual component of the pre-payment item and then average it for the test year period.

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: Cost on Fuel

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

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

5.2: Calculation on Important Terms

Plant Factor*:* Plant Factor (The net capacity factor of a power plant) is the ratio of KWh generated or 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.

$$\text{Plant factor} = \frac{\textbf{Generated Electricity in KWh}}{\textbf{Operating Capacity} \times \textbf{1000} \times \textbf{Hours in Current Month}}$$

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

$$\textit{Plant factor} = \frac{648{,}000}{1{,}000 \times 30 \times 24} = 0.90 = 90\%$$

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.

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

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/m^3).

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.

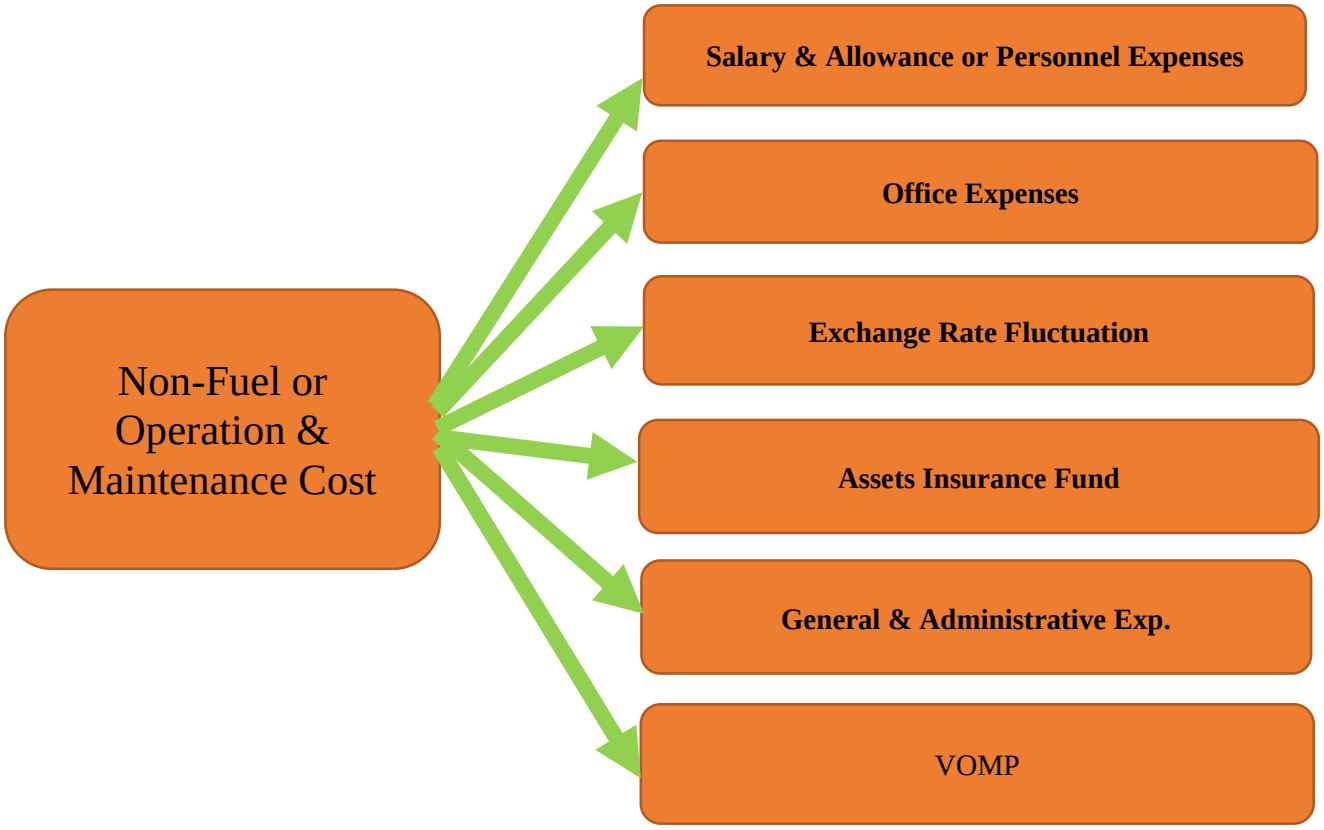

Figure 5.1: Parts of Non-Fuel or Operation & Maintenance Cost.

CHAPTER 6
TARIFF CALCULATION

6.1: Method of Tariff Calculation

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 costing of power plants. The advantage of this approach is that it explicitly examines the underlying structure of it. This study summarizes the tariff calculation of electricity generation. I've collected necessary data of several power plants from BERC (Bangladesh Energy Regulatory Commission). Then according to the standard formulas I have calculated the costing details of power plants including Fixed Cost (Depreciation, Loan, Equity and Regulatory Working Capital) and Variable Cost (Fuel Cost and Non-Fuel or Operation & Maintenance Cost). And according to these cost I have determined monthly tariff cost of electricity generation for several power plants.

6.2: Assumption Data-1

Name of Power Plant and Unit: Chittagong-Raujan, 210 MW power plant

Category of Technology: CC

Type of fuel: Gas

For Electricity Generation Cost Determination of **Chittagong-Raujan, 210 MW** power plant, the Assumption data is given below-

Table No.6.1: Assumption data-1

Assumption Data - 1			
SL NO	Parameter /Assumption /Boundary Condition		Unit
1	Net Capacity of the Power Plant	210	MW
2	Project Cost (MTk = 10^6 Tk)	14908	MTk
3	Exchange Rate	84.00	BDT/USD
4	Month Operation Hours	744	Hours
5	Calorific Value of Gass	1002.3	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 (70% of Total Debt)	60	%
10	Local/Commercial Loan facilities (30% 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	12	%
14	Effective Plant Life	15	Years
15	Loan Repayment	10	Years
16	Salvage Value	5	%

6.3: Project Cost

Table No.6.2: Project Cost

Project Cost			
SL NO	**Item**	**Cost (MTk)**	**Share (%)**
1.0	Intangible Plant	399.53	2.68%
2.0	Production Plant or Plant machinery and equipment	0.00	
2.1	Plant and machinery C&F,11/33 KV sub-station, Power Evacuation Line	12361.71	82.92%
3.0	General Plant	0.00	
3.1	Land and Land Development	189.33	1.27%
3.2	Infrastructure(Building & Civil Works)	494.95	3.32%
3.3	Office Furniture and Equipment	14.91	0.10%
3.4	Laboratory Equipment	7.45	0.05%
3.5	Transportation & Communication	7.45	0.05%
3.6	Transportation & Communication	101.37	0.68%
3.7	Miscellaneous Equipment	7.45	0.05%
3.8	Others tangible Equipment	7.45	0.05%
3.9	Interest During Construction	618.68	4.15%
3.10	Contingencies	697.69	4.68%
4.0	**Total project cost (1+2+3)**	**14908**	**100%**

Fixed Cost Calculation

6.4: Depreciation Calculation

Total Project = 14908×10^6 Tk

Salvage value = 5%

Plant life = 15 years

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

$$= \frac{14908 \times 10^6 - (14908 \times 10^6 \times 5\%)}{15}$$

= 944173333.3 Tk

$$\text{Monthly depreciation} = \frac{\mathbf{944173333.3}}{\mathbf{12}} \text{ Tk}$$

= 78681111.11 Tk

6.5: ECA loan calculation

Given that,

Loan/ Debt amount is 70% of Used and Useful Asset = $14908 \times 10^6 \times 0.70$

$= 1.04356 \times 10^{10}$ Tk

60% of total debt amount that is ECA loan = $1.04356 \times 10^{10} \times 0.60$

= 6261360000 Tk

Principal, P = 6261360000 Tk

Yearly interest rate, r = 10%

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

Number of installment, n = 40

We know that

Principal = A × PVIFA

$$6261360000 = A \times \frac{1 - \frac{1}{(1 + r/4)^n}}{r/4}$$

$$A = \frac{6261360000 \times r/4}{1 - \frac{1}{(1 + r/4)^n}}$$

$$A = \frac{6261360000 \times 10\%/4}{1 - \frac{1}{(1 + \frac{10\%}{4})^{40}}}$$

A = 249428996.9 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

Re-Payment of ECA Loan						
Quarters	***Principle beginning (Tk) (1)***	***Installment (Tk)(2)***	***Quarterly interest (Tk)(3)= (1)×(0.025)***	***Principle Repayment (Tk)(4)= (2)-(3)***	***Principle Ending (Tk) (5)=(1)-(4)***	***Yearly Interest(Tk)***
1st	6261360000.0	249428996.9	156534000.0	92894996.9	6168465003.1	
2nd	6168465003.1	249428996.9	154211625.1	95217371.8	6073247631.3	
3rd	6073247631.3	249428996.9	151831190.8	97597806.1	5975649825.2	
4th	5975649825.2	249428996.9	149391245.6	100037751.2	5875612074.0	**611968061.5**
5th	5875612074.0	249428996.9	146890301.8	102538695.0	5773073379.0	
6th	5773073379.0	249428996.9	144326834.5	105102162.4	5667971216.6	
7th	5667971216.6	249428996.9	141699280.4	107729716.5	5560241500.1	
8th	5560241500.1	249428996.9	139006037.5	110422959.4	5449818540.7	**571922454.2**
9th	5449818540.7	249428996.9	136245463.5	113183533.4	5336635007.4	
10th	5336635007.4	249428996.9	133415875.2	116013121.7	5220621885.7	
11th	5220621885.7	249428996.9	130515547.1	118913449.7	5101708436.0	
12th	5101708436.0	249428996.9	127542710.9	121886286.0	4979822150.0	**527719596.7**
13th	4979822150.0	249428996.9	124495553.7	124933443.1	4854888706.9	
14th	4854888706.9	249428996.9	121372217.7	128056779.2	4726831927.7	
15th	4726831927.7	249428996.9	118170798.2	131258198.7	4595573729.0	
16th	4595573729.0	249428996.9	114889343.2	134539653.6	4461034075.3	**478927912.8**
17th	4461034075.3	249428996.9	111525851.9	137903145.0	4323130930.3	
18th	4323130930.3	249428996.9	108078273.3	141350723.6	4181780206.7	
19th	4181780206.7	249428996.9	104544505.2	144884491.7	4036895715.0	
20th	4036895715.0	249428996.9	100922392.9	148506604.0	3888389111.0	**425071023.2**
21th	3888389111.0	249428996.9	97209727.8	152219269.1	3736169841.9	
22th	3736169841.9	249428996.9	93404246.0	156024750.8	3580145091.1	
23th	3580145091.1	249428996.9	89503627.3	159925369.6	3420219721.5	
24th	3420219721.5	249428996.9	85505493.0	163923503.8	3256296217.7	**365623094.1**
25th	3256296217.7	249428996.9	81407405.4	168021591.4	3088274626.2	
26th	3088274626.2	249428996.9	77206865.7	172222131.2	2916052495.0	
27th	2916052495.0	249428996.9	72901312.4	176527684.5	2739524810.5	
28th	2739524810.5	249428996.9	68488120.3	180940876.6	2558583933.9	**300003703.7**
29th	2558583933.9	249428996.9	63964598.3	185464398.5	2373119535.4	
30th	2373119535.4	249428996.9	59327988.4	190101008.5	2183018526.9	
31th	2183018526.9	249428996.9	54575463.2	194853533.7	1988164993.2	
32th	1988164993.2	249428996.9	49704124.8	199724872.0	1788440121.1	**227572174.7**
33th	1788440121.1	249428996.9	44711003.0	204717993.8	1583722127.3	
34th	1583722127.3	249428996.9	39593053.2	209835943.7	1373886183.6	
35th	1373886183.6	249428996.9	34347154.6	215081842.3	1158804341.3	
36th	1158804341.3	249428996.9	28970108.5	220458888.3	938345453.0	**147621319.3**
37th	938345453.0	249428996.9	23458636.3	225970360.5	712375092.4	
38th	712375092.4	249428996.9	17809377.3	231619619.6	480755472.9	
39th	480755472.9	249428996.9	12018886.8	237410110.1	243345362.8	
40th	243345362.8	249428996.9	6083634.1	243345362.8	0.0	**59370534.5**
Total		**9977159875**		**6261360000**		**3715799875**

Return on ECA loan per year (sum yearly interest rate/10) = 3715799875 / 10

= 371579987.5 Tk

Return on ECA loan per month (Return on loan per year/12) = 371579987.5 / 12

= 30964998.96 Tk

6.6: Commercial loan calculation

Given that,

Loan/ debt amount is 70% of used and useful Asset = $14908 \times 10^6 \times 0.70$

= 1.04356×10^{10} Tk

40% of total debt amount is commercial loan= $1.04356 \times 10^{10} \times 0.40$

= 4174240000 Tk

Principal, P = 4174240000 Tk

Yearly interest, r = 12%

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

Number of installments, n = 40

We know,

Principal = A × PVIFA

Or, $4174240000 = A \times \frac{1 - \frac{1}{(1 + r/4)^n}}{r/4}$

$A = \frac{4174240000 \times 3\%}{1 - \frac{1}{(1+3\%)^{40}}}$

= 180587548 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. 6.4: Commercial loan calculation:

Re-payment of Commercial Loan						
Quarters	***Principle beginning (Tk) (1)***	***Installment (Tk)(2)***	***Quarterly interest (Tk)(3)= (1)×(0.03)***	***Principle Repayment (Tk)(4)=(2)-(3)***	***Principle Ending (Tk)(5)=(1)-(4)***	***Yearly Interest(Tk)***
1st	4174240000	180587548	125227200	55360348	4118879652	
2nd	4118879652	180587548	123566390	57021159	4061858493	
3nd	4061858493	180587548	121855755	58731793	4003126699	
4th	4003126699	180587548	120093801	60493747	3942632952	490743145
5th	3942632952	180587548	118278989	62308560	3880324392	
6th	3880324392	180587548	116409732	64177817	3816146576	
7th	3816146576	180587548	114484397	66103151	3750043425	
8th	3750043425	180587548	112501303	68086246	3681957179	461674420
9th	3681957179	180587548	110458715	70128833	3611828347	
10th	3611828347	180587548	108354850	72232698	3539595649	
11th	3539595649	180587548	106187869	74399679	3465195970	
12th	3465195970	180587548	103955879	76631669	3388564301	428957314
13th	3388564301	180587548	101656929	78930619	3309633681	
14th	3309633681	180587548	99289010	81298538	3228335143	
15th	3228335143	180587548	96850054	83737494	3144597650	
16th	3144597650	180587548	94337929	86249619	3058348031	392133923
17th	3058348031	180587548	91750441	88837107	2969510923	
18th	2969510923	180587548	89085328	91502221	2878008703	
19th	2878008703	180587548	86340261	94247287	2783761416	
20th	2783761416	180587548	83512842	97074706	2686686710	350688872
21st	2686686710	180587548	80600601	99986947	2586699763	
22nd	2586699763	180587548	77600993	102986555	2483713207	
23rd	2483713207	180587548	74511396	106076152	2377637055	
24th	2377637055	180587548	71329112	109258437	2268378619	304042102
25th	2268378619	180587548	68051359	112536190	2155842429	
26th	2155842429	180587548	64675273	115912275	2039930153	
27th	2039930153	180587548	61197905	119389644	1920540510	
28th	1920540510	180587548	57616215	122971333	1797569177	251540751
29th	1797569177	180587548	53927075	126660473	1670908704	
30th	1670908704	180587548	50127261	130460287	1540448417	
31st	1540448417	180587548	46213453	134374096	1406074321	
32nd	1406074321	180587548	42182230	138405319	1267669002	192450019
33rd	1267669002	180587548	38030070	142557478	1125111524	
34th	1125111524	180587548	33753346	146834203	978277321	
35th	978277321	180587548	29348320	151239229	827038093	
36th	827038093	180587548	24811143	155776406	671261687	177031384
37th	671261687	180587548	20137851	160449698	510811990	
38th	510811990	180587548	15324360	165263189	345548801	
39th	345548801	180587548	10366464	170221084	175327717	
40th	175327717	180587548	5259832	175327717	0	51088506
Total		**7223501931**		**4174240000**		**3100350437**

Return commercial loan per year (sum of yearly interest rate/10) = 3100350437/10
=310035043.7 Tk

Return of commercial loan per month (Return on loan per year/ 12) = 310035043.7 /12
= 25836253.64 Tk

6.7: Equity calculation

Given that,

Equity amount is 30% of total rate base.

Since total rate base is = 14908×10^6 Tk

Therefore, equity amount = $14908 \times 10^6 \times 0.30$

= 4472400000 Tk

Principal, P = 4472400000 Tk

Return of equity rate, r = 15%

Effective plan life, n = 15 years

We know,

Principal = A × PVIFA

$$\text{Or, } 4472400000 = A \times \frac{1 - \frac{1}{(1+r)^n}}{r}$$

$$A = \frac{4472400000 \times r}{1 - \frac{1}{(1+r)^n}}$$

$$= \frac{4472400000 \times 15\%}{1 - \frac{1}{(1+15\%)^{15}}}$$

= 764856666 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

Return on Equity					
Quarters	***Principle beginning (Tk) (1)***	***Installment (Tk)(2)***	***Yearly Interest(Tk)(3) =(1)×(0.15)***	***Principle Repayment(Tk) (4)=(2)-(3)***	***Principle Ending (Tk)(5)=(1)-(4)***
1st	4472400000	764856666	670860000	93996666	4378403334
2nd	4378403334	764856666	656760500	108096166	4270307168
3rd	4270307168	764856666	640546075	124310591	4145996576
4th	4145996576	764856666	621899486	142957180	4003039397
5th	4003039397	764856666	600455909	164400757	3838638640
6th	3838638640	764856666	575795796	189060870	3649577770
7th	3649577770	764856666	547436665	217420001	3432157769
8th	3432157769	764856666	514823665	250033001	3182124768
9th	3182124768	764856666	477318715	287537951	2894586817
10th	2894586817	764856666	434188023	330668644	2563918173
11th	2563918173	764856666	384587726	380268940	2183649233
12th	2183649233	764856666	327547385	437309281	1746339951
13th	1746339951	764856666	261950993	502905674	1243434278
14th	1243434278	764856666	186515142	578341525	665092753
15th	665092753	764856666	99763913	665092753	0
Sum of Years Interest			7000449994		

Return equity per year (sum of yearly interest rate/15) = 7000449994/15

= 466696666.2666 Tk

Return on equity per month (return on equity per year/12) = 466696666.2666/12

= 38891388.86 Tk

6.8: Total fixed cost and per unit fixed cost

Table No.6.6: Total Fixed Cost

Total Fixed cost		
Item	***Monthly***	***Yearly***
depreciation expenses (Tk)	78681111.11	944173333.3
ECA loan (Tk)	309649989.6	3715799875
Commercial loan(Tk)	258362536.4	3100350437
Return on equity (Tk)	38891388.85	466696666.3
Total amount (Tk)	171396256.5	2056755078
Total amount (MTk)	171.40	2056.76

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

$= \frac{171.40 MTk}{70.59 MkWh}$

= 2.428 Tk/kWh

6.9: Variable cost calculation

Table No. 6.7: Power Production Statement

Variable cost Calculation			
Power production statement			
Month	***Fuel consumption (MCft)***	***Electricity Generation (MkWh)***	***Operating Capacity(MW)***
July	0.0404	70.59	210
Aug	0.0403	70.5	210
Sep	0.0401	70.1	210
Oct	0.0400	69.9	210
Nov	0.0398	69.8	210
Dec	0.0379	69.4	210
Jan	0.0405	70.3	210
Feb	0.0400	70	210
Mar	0.0390	70.6	210
Apr	0.0402	69.1	210
May	0.0405	69.7	210
Jun	0.0400	69.05	210

Fuel Cost Calculation

Plant capacity = 210 MW

Generated electricity = 70.59 MkWh.

Calorific value of fuel = 1002.32 kj/Cft.

Price of fuel = 79.82 Tk/kCft.

Fuel Consumption = 0.0404 MCft.

Hours in currents amount = 744

$$\text{Plant factor} = \frac{\textbf{Generated Electricity in kWh}}{\textbf{Operating Capacity} \times \textbf{1000} \times \textbf{Hours in Current Month}}$$

$$= \frac{70.59 \times 10^6}{210 \times 1000 \times 744}$$

$$= 45.19\%$$

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

$$= \frac{1002.32 \times 0.0404 \times 10^6}{70.59 \times 10^6}$$

$$= 3.47512 \text{ kj /kWh}$$

$$= 3475.12 \text{ kCal/kWh}$$

$$\text{Total fuel cost} = \text{Fuel price} \times \text{Fuel consumption}$$

$$= 10140 \times 0.0404$$

$$= 409.6 \text{ MTk}$$

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

$$= \frac{405.6 \text{ MTk}}{70.59 \text{ MkWh}}$$

$$= 5.80 \text{ Tk/ kWh}$$

6.10: Non-Fuel or Operation and Maintenance cost Calculation (July)

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

Non-Fuel or Operation and Maintenance cost Calculation (July)							
Components for Non-fuel cost (MTk)							
Month	***Total Personal Exp.***	***Office Expenses***	***Exchange rate Fluctuation***	***Assets Insurance Fund***	***General & Administrative Exp.***	***VOMP***	***Total Non-Fuel cost***
July	6.21	0.36	11.61	0.07	7.29	1.29	26.83
Aug	6.18	0.36	11.57	0.07	7.26	1.28	26.72
Sep	6.14	0.35	11.48	0.07	7.21	1.27	26.52
Oct	6.01	0.35	11.25	0.07	7.06	1.25	25.99
Nov	6.23	0.36	11.66	0.07	7.32	1.29	26.93
Dec	5.98	0.34	11.18	0.07	7.02	1.24	25.83
Jan	6.19	0.36	11.58	0.07	7.27	1.28	26.75
Feb	6.18	0.36	11.57	0.07	7.26	1.28	26.72
Mar	6.22	0.36	11.64	0.07	7.30	1.29	26.88
Apr	6.20	0.36	11.61	0.07	7.28	1.29	26.81
May	6.18	0.36	11.57	0.07	7.26	1.28	26.72
Jun	6.22	0.36	11.63	0.07	7.30	1.29	26.87
Total	73.94	4.28	138.35	0.84	86.83	15.33	319.57

Generated electricity = 70.59 M kWh

Total Non-fuel or operation and Maintenance cost = 26.383 MTk

Per unit non-fuel or O&M cost = $\frac{\textbf{Non-Fuel Cost MTk}}{\textbf{Generated Electricity MkWh}}$

$$= \frac{26.83\ \text{MTk}}{70.59\ \text{MkWh}}$$

$$= 0.38\ \text{Tk/kWh}$$

6.1.1: Chart of cost

Table No. 6.9: Chart of cost

Chart of Cost									
Month	***plant factor %***	***Heat Rate (kCal/ kWh)***	***Total Fuel Cost (MTk)***	***Per Unit Fuel Cost (Tk/ kWh)***	***Fixed Cost (MTk)***	***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	45.18	573.65	3.22	0.05	171.40	26.83	0.38	201.88	2.86
Aug	45.12	572.96	3.22	0.05	171.40	26.72	0.38	201.76	2.86
Sep	44.87	573.37	3.20	0.05	171.40	26.52	0.38	201.54	2.88
Oct	44.74	573.57	3.19	0.05	171.40	25.99	0.37	201.00	2.88
Nov	44.67	571.52	3.18	0.05	171.40	26.93	0.39	201.93	2.89
Dec	44.42	547.38	3.03	0.05	171.40	25.83	0.37	200.67	2.89
Jan	44.99	577.44	3.23	0.05	171.40	26.75	0.38	201.81	2.87
Feb	44.80	572.75	3.19	0.05	171.40	26.72	0.38	201.74	2.88
Mar	45.19	553.69	3.11	0.05	171.40	26.88	0.38	201.82	2.86
Apr	44.23	583.12	3.21	0.05	171.40	26.81	0.39	201.85	2.92
May	44.61	582.41	3.23	0.05	171.40	26.72	0.38	201.78	2.89
Jun	44.19	580.63	3.19	0.05	171.40	26.87	0.39	201.89	2.92

6.1.2: Assumption Data-2

Name of power plant and unit: Shikalbaha 150 MW power plant.

Category of technology: ST

Type of fuel: Coal

For Electricity Generation Cost Determination of **Shikalbaha 150 MW**, ST Coal Based Power Plant, the assumption data is given below –

Table No. 6.10: Assumption Data-2

Assumption Data - 2			
SL NO	***Parameter /Assumption /Boundary Condition***		***Unit***
1	Net Capacity of the Power Plant	150	MW
2	Project Cost (MTk = 10^6 Tk)	10829	MTk
3	Exchange Rate	84.00	BDT/USD
4	Month Operation Hours	744	Hours
5	Calorific Value of Coal	6072	kcal/kg
6	Fuel Price	8820	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	15	%
12	Rate of Interest of ECA Loan Facilities	10	%
13	Rate of Interest of Commercial Loan Facilities	12	%
14	Effective Plant Life	15	Years
15	Loan Repayment	10	Years
16	Salvage Value	5	%

6.1.3: Project cost

Table No. 6.1.1: Project cost

Project Cost			
SL NO	***Item***	***Cost (MTk)***	***Share (%)***
1.0	Intangible Plant	290.21	2.68%
2.0	Production Plant or Plant machinery and equipment	0	
2.1	Plant and machinery C&F,11/33 KV sub-station, Power Evacuation Line	8979.4	82.92%
3.0	General Plant	0	
3.1	Land and Land Development	137.52	1.27%
3.2	Infrastructure(Building & Civil Works)	359.52	3.32%
3.3	Office Furniture and Equipment	10.8	0.10%
3.4	Laboratory Equipment	5.4	0.05%
3.5	Transportation & Communication	5.4	0.05%
3.6	Transportation & Communication	73.6	0.68%
3.7	Miscellaneous Equipment	5.4	0.05%
3.8	Others tangible Equipment	5.4	0.05%
3.9	Interest During Construction	449.4	4.15%
3.10	Contingencies	506.79	4.68%
4.0	Total project cost (1+2+3)	**10829**	**100%**

Fixed cost calculation

6.1.4: Depreciation Calculation

Total project cost = 10829×10^6 Tk

Salvage value = 5%

Plant life = 15 years

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

$$= \frac{10829 \times 10^6 - (10829 \times 10^6 \times 5\%)}{15}$$

= 685836666.7 Tk

Monthly depreciation = 685836666.7 /12

= 57153055.56 Tk

6.1.5: ECA loan calculation

Given that,

Loan/ Debt amount is 70% of used and useful Asset = $10829 \times 10^6 \times .70$

= 7580300000 Tk

60% of total debt amount that is ECA loan = 7580300000×0.60

= 4548180000 Tk

Principal, P = 4548180000 Tk

Yearly interest rate, r = 10%

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

Number of installment, n = 40

We know,

Principal = A × PVIFA

Or, $4548180000 = A \times \frac{1 - \frac{1}{(1 + r/4)^n}}{r/4}$

$A = \frac{4548180000 \times (10\%/4)}{1 - \frac{1}{(1 + \frac{10\%}{4})\text{^}40}}$

A = 181182358.9 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. 6.1.2: ECA Loan Calculation

Re-Payment of ECA Loan						
Quarter	***Principle beginning (Tk) (1)***	***Installment (Tk)(2)***	***Quarterly interest (Tk)(3)=(1)× (0.025)***	***Principle Repayment (Tk)(4) =(2)-(3)***	***Principle Ending (Tk) (5)=(1)-(4)***	***Yearly Interest(Tk)***
1st	4548180000.0	181182358.9	113704500.0	67477858.9	4480702141.1	
2nd	4480702141.1	181182358.9	112017553.5	69164805.4	4411537335.6	
3rd	4411537335.6	181182358.9	110288433.4	70893925.6	4340643410.1	
4th	4340643410.1	181182358.9	108516085.3	72666273.7	4267977136.4	444526572.2
5th	4267977136.4	181182358.9	106699428.4	74482930.5	4193494205.9	
6th	4193494205.9	181182358.9	104837355.1	76345003.8	4117149202.1	
7th	4117149202.1	181182358.9	102928730.1	78253628.9	4038895573.2	
8th	4038895573.2	181182358.9	100972389.3	80209969.6	3958685603.5	415437902.9
9th	3958685603.5	181182358.9	98967140.1	82215218.9	3876470384.7	
10th	3876470384.7	181182358.9	96911759.6	84270599.3	3792199785.4	
11th	3792199785.4	181182358.9	94804994.6	86377364.3	3705822421.1	
12th	3705822421.1	181182358.9	92645560.5	88536798.4	3617285622.6	383329454.9
13th	3617285622.6	181182358.9	90432140.6	90750218.4	3526535404.3	
14th	3526535404.3	181182358.9	88163385.1	93018973.8	3433516430.4	
15th	3433516430.4	181182358.9	85837910.8	95344448.2	3338171982.2	
16th	3338171982.2	181182358.9	83454299.6	97728059.4	3240443922.8	347887736.0
17th	3240443922.8	181182358.9	81011098.1	100171260.9	3140272662.0	
18th	3140272662.0	181182358.9	78506816.5	102675542.4	3037597119.6	
19th	3037597119.6	181182358.9	75939928.0	105242431.0	2932354688.6	
20th	2932354688.6	181182358.9	73308867.2	107873491.7	2824481196.9	308766709.8
21th	2824481196.9	181182358.9	70612029.9	110570329.0	2713910867.9	
22th	2713910867.9	181182358.9	67847771.7	113334587.2	2600576280.6	
23th	2600576280.6	181182358.9	65014407.0	116167951.9	2484408328.7	
24th	2484408328.7	181182358.9	62110208.2	119072150.7	2365336178.0	265584416.9
25th	2365336178.0	181182358.9	59133404.4	122048954.5	2243287223.5	
26th	2243287223.5	181182358.9	56082180.6	125100178.4	2118187045.1	
27th	2118187045.1	181182358.9	52954676.1	128227682.8	1989959362.3	
28th	1989959362.3	181182358.9	49748984.1	131433374.9	1858525987.4	217919245.2
29th	1858525987.4	181182358.9	46463149.7	134719209.3	1723806778.1	
30th	1723806778.1	181182358.9	43095169.5	138087189.5	1585719588.6	
31th	1585719588.6	181182358.9	39642989.7	141539369.2	1444180219.4	
32th	1444180219.4	181182358.9	36104505.5	145077853.5	1299102366.0	165305814.3
33th	1299102366.0	181182358.9	32477559.1	148704799.8	1150397566.2	
34th	1150397566.2	181182358.9	28759939.2	152422419.8	997975146.4	
35th	997975146.4	181182358.9	24949378.7	156232980.3	841742166.1	
36th	841742166.1	181182358.9	21043554.2	160138804.8	681603361.3	107230431.1
37th	681603361.3	181182358.9	17040084.0	164142274.9	517461086.4	
38th	517461086.4	181182358.9	12936527.2	168245831.8	349215254.6	
39th	349215254.6	181182358.9	8730381.4	172451977.6	176763277.0	
40th	176763277.0	181182358.9	4419081.9	176763277.0	0.0	43126074.5
Total		7247294358		4548180000		2699114358

Return on commercial loan per year (sum of yearly interest rate/10) = 2699114358/10
= 269911435.8 Tk

Return on commercial loan per month (Return on loan per year/ 12) = 269911435.8/12
= 22492619.65 Tk

6.1.6: Commercial loan calculation:

Given that,

Loan/ Debt amount is 70% of used and useful Asset = $10829 \times 10^6 \times 0.70$ = 7580300000 Tk

40% of total debt amount that is commercial loan = 7580300000×0.40 = 3032120000 Tk

Principal, P = 3032120000 Tk

Yearly interest rate, r = 12%

Quarterly interest rate (r/4) = 3%

Number of installment, n = 40

We know,

Principal A × PVIFA

Or, $399735560 = A \times \frac{1 - \frac{1}{(1 + r/4)^n}}{r/4}$

$A = \frac{399735560 \times 3\%}{1 - \frac{1}{(1 + 3\%)\text{^}40}}$

A = 172935109 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. 6.1.3: Commercial loan calculation

Re-payment of Commercial Loan						
Quarters	***Principle beginning (Tk) (1)***	***Installment (Tk)(2)***	***Quarterly interest (Tk)(3)=(1) ×(0.03)***	***Principle Repayment (Tk)(4)= (2)-(3)***	***Principle Ending (Tk)(5)= (1)-(4)***	***Yearly Interest(Tk)***
1st	3032120000	131176721	90963600	40213121	2991906879	
2nd	2991906879	131176721	89757206	41419515	2950487364	
3nd	2950487364	131176721	88514621	42662100	2907825264	
4th	2907825264	131176721	87234758	43941963	2863883300	356470185
5th	2863883300	131176721	85916499	45260222	2818623078	
6th	2818623078	131176721	84558692	46618029	2772005049	
7th	2772005049	131176721	83160151	48016570	2723988479	
8th	2723988479	131176721	81719654	49457067	2674531412	335354997
9th	2674531412	131176721	80235942	50940779	2623590634	
10th	2623590634	131176721	78707719	52469002	2571121631	
11th	2571121631	131176721	77133649	54043072	2517078559	
12th	2517078559	131176721	75512357	55664364	2461414194	311589667
13th	2461414194	131176721	73842426	57334295	2404079899	
14th	2404079899	131176721	72122397	59054324	2345025575	
15th	2345025575	131176721	70350767	60825954	2284199621	
16th	2284199621	131176721	68525989	62650733	2221548888	284841579
17th	2221548888	131176721	66646467	64530255	2157018634	
18th	2157018634	131176721	64710559	66466162	2090552471	
19th	2090552471	131176721	62716574	68460147	2022092324	
20th	2022092324	131176721	60662770	70513952	1951578373	254736370
21st	1951578373	131176721	58547351	72629370	1878949003	
22nd	1878949003	131176721	56368470	74808251	1804140751	
23rd	1804140751	131176721	54124223	77052499	1727088253	
24th	1727088253	131176721	51812648	79364074	1647724179	220852691
25th	1647724179	131176721	49431725	81744996	1565979183	
26th	1565979183	131176721	46979375	84197346	1481781837	
27th	1481781837	131176721	44453455	86723266	1395058571	
28th	1395058571	131176721	41851757	89324964	1305733607	182716313
29th	1305733607	131176721	39172008	92004713	1213728894	
30th	1213728894	131176721	36411867	94764854	1118964040	
31st	1118964040	131176721	33568921	97607800	1021356240	
32nd	1021356240	131176721	30640687	100536034	920820206	139793483
33rd	920820206	131176721	27624606	103552115	817268091	
34th	817268091	131176721	24518043	106658679	710609412	
35th	710609412	131176721	21318282	109858439	600750973	
36th	600750973	131176721	18022529	113154192	487596781	128593564
37th	487596781	131176721	14627903	116548818	371047963	
38th	371047963	131176721	11131439	120045282	251002681	
39th	251002681	131176721	7530080	123646641	127356040	
40th	127356040	131176721	3820681	127356040	0	37110104
Total		**5247068850**		**3032120000**		**2252058954**

Return on commercial loan per year (sum of yearly interest rate/10) = 2252058954/10
= 225205895.4 Tk

Return on commercial loan per month (Return on loan per year/ 12) = 225205895.4 /12
= 18767157.95 Tk

6.1.7: Equity calculation

Given that,

Equity amount is 30% of total rate base.

Since total rate base is = 10829×10^6 Tk

Therefore, Equity amount = $10829 \times 10^6 \times 0.30$= 3248700000 Tk

Principal, P = 3248700000 Tk

Return of equity rate, r = 15%

Effective plant life, n = 15 years

We know,

Principal = A × PVIFA

$$\text{Or, } 3248700000 = A \times \frac{1-\frac{1}{(1+r)^n}}{r}$$

$$A = \frac{3248700000}{1-\frac{1}{(1+r)\text{^}n}}$$

$$A = \frac{4282881000 \times 15\%}{1-\frac{1}{(1+15\%)\text{^}15}}$$

= 555583099 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. 6.1.4: Equity calculation

Return on Equity					
Quarters	***Principle beginning (Tk) (1)***	***Installment (Tk)(2)***	***Yearly Interest(Tk)(3) =(1)×(0.15)***	***Principle Repayment(Tk)(4)= (2)-(3)***	***Principle Ending (Tk)(5)=(1)-(4)***
1st	3248700000	555583099	487305000	68278099	3180421901
2nd	3180421901	555583099	477063285	78519814	3101902087
3rd	3101902087	555583099	465285313	90297786	3011604301
4th	3011604301	555583099	451740645	103842454	2907761848
5th	2907761848	555583099	436164277	119418822	2788343026
6th	2788343026	555583099	418251454	137331645	2651011381
7th	2651011381	555583099	397651707	157931392	2493079989
8th	2493079989	555583099	373961998	181621101	2311458889
9th	2311458889	555583099	346718833	208864266	2102594623
10th	2102594623	555583099	315389193	240193905	1862400717
11th	1862400717	555583099	279360108	276222991	1586177726
12th	1586177726	555583099	237926659	317656440	1268521286
13th	1268521286	555583099	190278193	365304906	903216380
14th	903216380	555583099	135482457	420100642	483115738
15th	483115738	555583099	72467361	483115738	0
Sum of Years Interest			**5085046484**		

Return on equity per year (sum of yearly interest rate/15) = 5085046484/15

= 32207715.87 Tk

Return on equity per month (return on equity per year/12) = 32207715.87

= 2683976.33 Tk

6.1.8: Total fixed cost and per unit fixed cost

Table No. 6.1.5: Total Fixed cost

Total Fixed cost		
Item	***Monthly***	***Yearly***
depreciation expenses (Tk)	57153055.56	685836666.7
ECA loan (Tk)	224926196.5	2699114358
Commercial loan (Tk)	187671579.5	2252058954
Return on equity (Tk)	28250258.24	339003098.9
Total amount (Tk)	124500272.4	1494003269
Total amount (MTk)	**124.50**	**1494.00**

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

$= \frac{124.50\,MTk}{70.59\,MkMh}$

= 1.764 Tk/kWh

6.1.9: Variable cost calculation

Table No.6.1.6: Power production statement

Variable cost Calculation			
Power production statement			
Month	***Fuel consumption (MTon)***	***Electricity Generation (MkWh)***	***Operating Capacity(MW)***
July	0.0404	70.59	150
Aug	0.0403	70.5	150
Sep	0.0401	70.1	150
Oct	0.0400	69.9	150
Nov	0.0398	69.8	150
Dec	0.0379	69.4	150
Jan	0.0405	70.3	150
Feb	0.0400	70	150
Mar	0.0390	70.6	150
Apr	0.0402	69.1	150
May	0.0405	69.7	150
Jun	0.0400	69.05	150

6.1.10: Fuel cost calculation (July)

Plant capacity = 150 MW

Generated electricity = 70.59 MkWh

Calorific value of fuel = 6072 kCal/kg

Price of fuel = 8820 Tk/Ton

Fuel Consumption = 0.0404 MTon

Hours in currents amount =744

$$\text{Plant factor} = \frac{\textbf{Generated Electricity in kWh}}{\textbf{Operating Capacity} \times \textbf{1000} \times \textbf{Hours in Current Month}}$$

$$= \frac{79.59 \times 10^6}{150 \times 1000 \times 744}$$

$$= 71.31\%$$

$$\text{Hate rate} = \frac{\textbf{Calorific Value of Fuel} \times \textbf{Fuel Consumtion}}{\textbf{Generated Electricity}} = \frac{6072 \times 0.0404 \times 10^6}{70.59 \times 10^6}$$

$$= 3.47512 \text{ kj/kWh}$$

$$= 3475.12 \text{ kCal/kWh}$$

$$\text{Total fuel cost} = \text{Fuel price} \times \text{Fuel consumption}$$

$$= 8820 \times 0.0404$$

$$= 356.328 \text{ MTk}$$

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

$$= \frac{356.32 \text{MTk}}{70.59 \text{MkWh}}$$

$$= 5.05 \text{ Tk / kWh}$$

6.2.1: Non-Fuel or Operation and Maintenance cost Calculation (July)

Table No. 6.1.7: Components for Non-Fuel Cost (MTk)

Non-Fuel or Operation and Maintenance cost Calculation (July)							
Components for Non-Fuel Cost (MTk)							
Month	***Total Personal Exp.***	***Office Expenses***	***Exchange rate Fluctuation***	***Assets Insurance Fund***	***General & Administrative Exp.***	***VOMP***	***Total Non-Fuel cost***
July	6.21	0.36	11.61	0.07	7.29	1.29	26.83
Aug	6.18	0.36	11.57	0.07	7.26	1.28	26.72
Sep	6.14	0.35	11.48	0.07	7.21	1.27	26.52
Oct	6.01	0.35	11.25	0.07	7.06	1.25	25.99
Nov	6.23	0.36	11.66	0.07	7.32	1.29	26.93
Dec	5.98	0.34	11.18	0.07	7.02	1.24	25.83
Jan	6.19	0.36	11.58	0.07	7.27	1.28	26.75
Feb	6.18	0.36	11.57	0.07	7.26	1.28	26.72
Mar	6.22	0.36	11.64	0.07	7.30	1.29	26.88
Apr	6.20	0.36	11.61	0.07	7.28	1.29	26.81
May	6.18	0.36	11.57	0.07	7.26	1.28	26.72
Jun	6.22	0.36	11.63	0.07	7.30	1.29	26.87
Total	73.94	4.28	138.35	0.84	86.83	15.33	319.57

Generated electricity = 70.59 MkWh

Total Non-fuel or operation and Maintenance cost = 26.383 MTk

Per unit non-fuel or O & M cost = $\frac{\textbf{Non-Fuel Cost MTk}}{\textbf{Generated Electricity MkWh}}$

$$= \frac{26.83\,\mathrm{MTk}}{70.59\,\mathrm{MkWh}}$$

= 0.38 Tk/kWh

6.2.2: Chart of Cost

Table No. 6.1.8: Chart of Cost

Chart of Cost									
Month	***plant factor %***	***Heat Rate (kCal/kWh)***	***Total Fuel Cost (MTk)***	***Per Unit Fuel Cost (Tk/kWh)***	***Fixed Cost (MTk)***	***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	63.25	3475.12	356.33	5.05	124.50	26.83	0.38	513.09	7.27
Aug	63.17	3470.94	355.45	5.05	124.50	26.72	0.38	512.09	7.26
Sep	62.81	3473.43	353.68	5.05	124.50	26.52	0.38	510.13	7.28
Oct	62.63	3474.68	352.80	5.05	124.50	25.99	0.37	508.71	7.28
Nov	62.54	3462.26	351.04	5.05	124.50	26.93	0.39	507.90	7.28
Dec	62.19	3315.98	334.28	5.05	124.50	25.83	0.37	490.03	7.06
Jan	62.99	3498.09	357.21	5.05	124.50	26.75	0.38	513.89	7.31
Feb	62.72	3469.71	352.80	5.05	124.50	26.72	0.38	509.45	7.28
Mar	63.26	3354.22	343.98	5.05	124.50	26.88	0.38	500.79	7.09
Apr	61.92	3532.48	354.56	5.05	124.50	26.81	0.39	511.31	7.40
May	62.46	3528.21	357.21	5.05	124.50	26.72	0.38	513.86	7.37
Jun	61.87	3517.45	352.80	5.05	124.50	26.87	0.39	509.61	7.38

6.2.3: Assumption data-3

Name of power plant and unit: Bheramara 225 MW power plant

Category of technology: CT

Type of fuel: High Speed Diesel

For Electricity Generation Cost Determination of **Bheramara 225 MW**, CT **High Speed Diesel** Based Power Plant, the assumption data is given below –

Table No. 6.1.9: Assumption Data 3

Assumption Data - 3			
SL NO	Parameter /Assumption /Boundary Condition		Unit
1	Net Capacity of the Power Plant	225	MW
2	Project Cost (MTk = 10^6 Tk)	16244	MTk
3	Exchange Rate	84	BDT/USD
4	Month Operation Hours	744	Hours
5	Calorific Value of Diesel	36900	kj/litre
6	Fuel Price	61	Tk/litre
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	15	%
12	Rate of Interest of ECA Loan Facilities	10	%
13	Rate of Interest of Commercial Loan Facilities	12	%
14	Effective Plant Life	15	Years
15	Loan Repayment	10	Years
16	Salvage Value	5	%

6.2.4: Project Cost

Table No. 6.1.10: Project cost

Project Cost			
SL NO	***Item***	***Cost (MTk)***	***Share (%)***
1.0	Intangible Plant	435.3	2.68%
2.0	Production Plant or Plant machinery and equipment	0	
2.1	Plant and machinery C&F,11/33 KV sub-station, Power Evacuation Line	13469.5	82.92%
3.0	General Plant	0	
3.1	Land and Land Development	206.29	1.27%
3.2	Infrastructure(Building & Civil Works)	539.30	3.32%
3.3	Office Furniture and Equipment	16.24	0.10%
3.4	Laboratory Equipment	8.12	0.05%
3.5	Transportation & Communication	8.12	0.05%
3.6	Transportation & Communication	110.45	0.68%
3.7	Miscellaneous Equipment	8.12	0.05%
3.8	Others tangible Equipment	8.12	0.05%
3.9	Interest During Construction	674.12	4.15%
3.10	Contingencies	760.21	4.68%
4.0	Total project cost (1+2+3)	**16244**	**100%**

Fixed cost calculation

6.2.5: Depreciation calculation:

Total project cost = 16244×10^6 Tk

Salvage value = 10%

Plant life = 15 years

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

$$= \frac{16244 \times 10^6 - 16244 \times 10^6 \times 10\%}{15}$$

$$= 9746400000 \text{ Tk}$$

Monthly depreciation = 9746400000/12

= 81220000 Tk

6.2.6: ECA Loan Calculation

Given that

Loan/debt amount is 70% of used and useful asset

$$= 16244 \times 0.70 \times 10^6 \text{ Tk}$$

$$= 11370800000 \text{ Tk}$$

60% of total debt amount that ECA loan = 11370800000×0.60

$$= 6822480000 \text{ Tk}$$

Principal beginning,

P = 6822480000 Tk

Yearly interest rate r = 10%

Quarterly interest rate (r/4) = 2.5%

Number of installment in = 40

We know,

Principal = A × PVIFA

$$\text{Or, } 6822480000 = A \times \frac{1 - \frac{1}{(1 + r/4)^n}}{r/4}$$

$$A = \frac{6822480000 \times 2.5\%}{1 - \frac{1}{(1 + 2.5\%)\text{^}40}}$$

= 271781904 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. 6.2.1: ECA Loan Calculation

Re-Payment of ECA Loan						
Quarters	***Principle beginning (Tk) (1)***	***Installment (Tk)(2)***	***Quarterly interest (Tk)(3)=(1) ×(0.025)***	***Principle Repayment (Tk)(4)=(2)-(3)***	***Principle Ending (Tk)(5)=(1)-(4)***	***Yearly Interest(Tk)***
1st	6822480000.0	271781904.0	170562000.0	101219904.0	6721260096.0	
2nd	6721260096.0	271781904.0	168031502.4	103750401.6	6617509694.3	
3rd	6617509694.3	271781904.0	165437742.4	106344161.7	6511165532.7	
4th	6511165532.7	271781904.0	162779138.3	109002765.7	6402162767.0	666810383.1
5th	6402162767.0	271781904.0	160054069.2	111727834.9	6290434932.1	
6th	6290434932.1	271781904.0	157260873.3	114521030.7	6175913901.4	
7th	6175913901.4	271781904.0	154397847.5	117384056.5	6058529844.9	
8th	6058529844.9	271781904.0	151463246.1	120318657.9	5938211187.0	623176036.1
9th	5938211187.0	271781904.0	148455279.7	123326624.4	5814884562.6	
10th	5814884562.6	271781904.0	145372114.1	126409790.0	5688474772.7	
11th	5688474772.7	271781904.0	142211869.3	129570034.7	5558904738.0	
12th	5558904738.0	271781904.0	138972618.4	132809285.6	5426095452.4	575011881.5
13th	5426095452.4	271781904.0	135652386.3	136129517.7	5289965934.7	
14th	5289965934.7	271781904.0	132249148.4	139532755.7	5150433179.0	
15th	5150433179.0	271781904.0	128760829.5	143021074.6	5007412104.5	
16th	5007412104.5	271781904.0	125185302.6	146596601.4	4860815503.1	521847666.8
17th	4860815503.1	271781904.0	121520387.6	150261516.4	4710553986.6	
18th	4710553986.6	271781904.0	117763849.7	154018054.4	4556535932.3	
19th	4556535932.3	271781904.0	113913398.3	157868505.7	4398667426.5	
20th	4398667426.5	271781904.0	109966685.7	161815218.4	4236852208.2	463164321.2
21th	4236852208.2	271781904.0	105921305.2	165860598.8	4070991609.3	
22th	4070991609.3	271781904.0	101774790.2	170007113.8	3900984495.6	
23th	3900984495.6	271781904.0	97524612.4	174257291.6	3726727203.9	
24th	3726727203.9	271781904.0	93168180.1	178613723.9	3548113480.0	398388887.9
25th	3548113480.0	271781904.0	88702837.0	183079067.0	3365034413.0	
26th	3365034413.0	271781904.0	84125860.3	187656043.7	3177378369.3	
27th	3177378369.3	271781904.0	79434459.2	192347444.8	2985030924.5	
28th	2985030924.5	271781904.0	74625773.1	197156130.9	2787874793.5	326888929.7
29th	2787874793.5	271781904.0	69696869.8	202085034.2	2585789759.4	
30th	2585789759.4	271781904.0	64644744.0	207137160.0	2378652599.3	
31th	2378652599.3	271781904.0	59466315.0	212315589.0	2166337010.3	
32th	2166337010.3	271781904.0	54158425.3	217623478.8	1948713531.5	247966354.1
33th	1948713531.5	271781904.0	48717838.3	223064065.7	1725649465.8	
34th	1725649465.8	271781904.0	43141236.6	228640667.4	1497008798.4	
35th	1497008798.4	271781904.0	37425220.0	234356684.1	1262652114.3	
36th	1262652114.3	271781904.0	31566302.9	240215601.2	1022436513.2	160850597.7
37th	1022436513.2	271781904.0	25560912.8	246220991.2	776215522.0	
38th	776215522.0	271781904.0	19405388.0	252376516.0	523839006.0	
39th	523839006.0	271781904.0	13095975.1	258685928.9	265153077.1	
40th	265153077.1	271781904.0	6628826.9	265153077.1	0.0	64691103.0
Total		**10871276161**		**6822480000**		**4048796161**

Return on ECA loan per year (sum of yearly interest rate /10) = 4048796161/10

= 404879616.1 Tk

Return on ECA loan per month (return on loan per year/12) = 404879616.1 /12

= 33739968 Tk

6.2.7: Commercial loan calculation

Given that,

Loan/ debt amount is 70% of used and useful Asset = $16244 \times 0.70 \times 10^6$ Tk

= 11370800000 Tk

40% of total debt amount that is commercial loan = 11370800000×0.40 = 4548320000 Tk

Principal, P = 4548320000 Tk

Yearly interest rate, r = 12%

Quarterly interest rate (r/4) = 3 %

Number of installment n = 40

We know that,

Principal =$A \times PVIFA$

Or, $4548320000 = A \times \frac{1 - \frac{1}{(1 + r/4)^n}}{r/4}$

$A = \frac{4548320000 \times 3\%}{1 - \frac{1}{(1+3\%)^{40}}}$

= 196774139 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. 6.2.2: Commercial loan calculation

Re-payment of Commercial Loan						
Quarters	***Principle beginning (Tk) (1)***	***Installment (Tk)(2)***	***Quarterly interest (Tk)(3)=(1) ×(0.03)***	***Principle Repayment (Tk)(4)= (2)-(3)***	***Principle Ending (Tk)(5)= (1)-(4)***	***Yearly Interest(Tk)***
1st	4548320000	196771139	136449600	60321539	4487998461	
2nd	4487998461	196771139	134639954	62131185	4425867277	
3nd	4425867277	196771139	132776018	63995120	4361872156	
4th	4361872156	196771139	130856165	65914974	4295957182	534721737
5th	4295957182	196771139	128878715	67892423	4228064759	
6th	4228064759	196771139	126841943	69929196	4158135563	
7th	4158135563	196771139	124744067	72027072	4086108492	
8th	4086108492	196771139	122583255	74187884	4011920608	503047980
9th	4011920608	196771139	120357618	76413520	3935507088	
10th	3935507088	196771139	118065213	78705926	3856801162	
11th	3856801162	196771139	115704035	81067104	3775734058	
12th	3775734058	196771139	113272022	83499117	3692234941	467398887
13th	3692234941	196771139	110767048	86004090	3606230851	
14th	3606230851	196771139	108186926	88584213	3517646637	
15th	3517646637	196771139	105529399	91241739	3426404898	
16th	3426404898	196771139	102792147	93978992	3332425906	427275520
17th	3332425906	196771139	99972777	96798361	3235627545	
18th	3235627545	196771139	97068826	99702312	3135925233	
19th	3135925233	196771139	94077757	102693382	3033231851	
20th	3033231851	196771139	90996956	105774183	2927457668	382116316
21st	2927457668	196771139	87823730	108947409	2818510259	
22nd	2818510259	196771139	84555308	112215831	2706294428	
23rd	2706294428	196771139	81188833	115582306	2590712123	
24th	2590712123	196771139	77721364	119049775	2471662348	331289234
25th	2471662348	196771139	74149870	122621268	2349041080	
26th	2349041080	196771139	70471232	126299906	2222741173	
27th	2222741173	196771139	66682235	130088903	2092652270	
28th	2092652270	196771139	62779568	133991571	1958660700	274082906
29th	1958660700	196771139	58759821	138011318	1820649382	
30th	1820649382	196771139	54619481	142151657	1678497725	
31st	1678497725	196771139	50354932	146416207	1532081518	
32nd	1532081518	196771139	45962446	150808693	1381272825	209696680
33rd	1381272825	196771139	41438185	155332954	1225939871	
34th	1225939871	196771139	36778196	159992942	1065946928	
35th	1065946928	196771139	31978408	164792731	901154198	
36th	901154198	196771139	27034626	169736513	731417685	192896284
37th	731417685	196771139	21942531	174828608	556589077	
38th	556589077	196771139	16697672	180073466	376515611	
39th	376515611	196771139	11295468	185475670	191039940	
40th	191039940	196771139	5731198	191039940	0	55666869
Total		**7870845544**		**4548320000**		**3378192414**

Return on commercial loan per year (sum of yearly interest rate/10) = 3378192414/10

=337819241.4 Tk

Return on commercial loan per month (Return on loan per yearly/12) = 337819241.4 /12

=28151603.45 Tk

6.2.8: Equity calculation

Given that,

Equity amount is 30% of total base rate

Since total rate base is = 16244×10^6 Tk

Therefore, Equity amount = $16244 \times 10^6 \times 0.30$ = 4873200000 Tk

Principal, P = 4873200000 Tk

Return on equity rate in, r = 15%

Effective plant life in = 15 years

We know that,

Principal = A × PVIFA or, $4873200000 = A \times \frac{1 - \frac{1}{(1+r)^n}}{r}$

$$A = \frac{4873200000 \times r}{1 - \frac{1}{(1+r)^n}}$$

$$A = \frac{4873200000 \times 15\%}{1 - \frac{1}{(1+15\%)^{15}}}$$

A = 833400301 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. 6.2.3: Equity calculation

Return on Equity					
Quarters	***Principle beginning (Tk) (1)***	***Installment (Tk)(2)***	***Yearly Interest(Tk)(3) =(1)×(0.15)***	***Principle Repayment (Tk)(4)=(2)-(3)***	***Principle Ending (Tk)(5)=(1)-(4)***
1st	4873200000	833400301	730980000	102420301	4770779699
2nd	4770779699	833400301	715616955	117783346	4652996353
3rd	4652996353	833400301	697949453	135450848	4517545505
4th	4517545505	833400301	677631826	155768475	4361777030
5th	4361777030	833400301	654266554	179133746	4182643283
6th	4182643283	833400301	627396492	206003808	3976639475
7th	3976639475	833400301	596495921	236904380	3739735095
8th	3739735095	833400301	560960264	272440037	3467295058
9th	3467295058	833400301	520094259	313306042	3153989016
10th	3153989016	833400301	473098352	360301949	2793687068
11th	2793687068	833400301	419053060	414347241	2379339827
12th	2379339827	833400301	356900974	476499327	1902840500
13th	1902840500	833400301	285426075	547974226	1354866274
14th	1354866274	833400301	203229941	630170360	724695914
15th	724695914	833400301	108704387	724695914	0
Sum of Years Interest			**7627804514**		

Return on equity per year (sum of yearly interest rate/15) = 7627804514/15

= 508520300 Tk

Return on per month (Return on equity per year/ 12) = 508520300/12

= 42376691.74 Tk

6.2.9: Total fixed cost and per unit fixed cost

Table No. 6.2.4: Fixed cost

Total Fixed cost		
Item	***Monthly***	***Yearly***
depreciation expenses (Tk)	85732222.22	1028786667
ECA loan (Tk)	337399680.1	4048796161
Commercial loan (Tk)	281516034.5	3378192414
Return on equity (Tk)	42376691.75	508520301
Total amount (Tk)	186756157.1	2241073886
Total amount (MTk)	**186.76**	**2241.07**

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

$= \frac{185.63\,\mathrm{MTk}}{70.59\,\mathrm{MkWh}}$

= 2.63 Tk/ kWh.

6.2.10: Variable cost calculation

Table No. 6.2.5: Power production statement

Variable cost Calculation			
Power production statement			
Month	***Fuel consumption (MLitre)***	***Electricity Generation (MkWh)***	***Operating Capacity(MW)***
July	0.0404	70.59	225
Aug	0.0403	70.5	225
Sep	0.0401	70.1	225
Oct	0.0400	69.9	225
Nov	0.0398	69.8	225
Dec	0.0379	69.4	225
Jan	0.0405	70.3	225
Feb	0.0400	70	225
Mar	0.0390	70.6	225
Apr	0.0402	69.1	225
May	0.0405	69.7	225
Jun	0.0400	69.05	225

6.3.1: Fuel cost calculation (July)

Operating capacity = 225 MW

Fuel consumption = 0.0404 M/litre

Fuel price = 61 Tk/ litre

Calorific value of fuel HSD = 36,900 kj./Litre

Hours in current month = 744

$$\text{Plan factor} = \frac{\textbf{Generated Electricity in kWh}}{\textbf{Operating Capacity} \times \textbf{1000} \times \textbf{Hours in Current Month}}$$

$$= \frac{70.59 \times 10^6}{225 \times 1000 \times 744}$$

= 42.17%

$$\text{Hate rate} = \frac{\textbf{Calorific Value of Fuel} \times \textbf{Fuel Consumtion}}{\textbf{Generated Electricity}} = \frac{36900\ \text{kj} \times 0.0404}{70.59\ \text{kWh}}$$

= 21.118 kj/ kWh

= 5.0474 kCal/kWh

Total feel cost = Fuel price $\times$ fuel consumption = 61 Tk/litre $\times$ 0.0404 Mlitre

= 2.464 MTk

$$\text{Fuel cost per unit energy} = \frac{\text{Total fuel cost}}{\text{Generated elecricity}}$$

$$= \frac{2.464\ \text{MTk}}{70.59\ \text{MkWh}}$$

= .0349 Tk /kWh

6.3.2: Non-Fuel or Operation and Maintenance cost Calculation (July)

Table No. 6.2.6: Components for Non-fuel cost (MTk)

Non-Fuel or Operation and Maintenance cost Calculation (July)							
Components for Non-fuel cost (MTk)							
Month	***Total Personal Exp.***	***Office Expenses***	***Exchange rate Fluctuation***	***Assets Insurance Fund***	***General & Administrative Exp.***	***VOMP***	***Total Non-Fuel cost***
July	6.21	0.36	11.61	0.07	7.29	1.29	26.83
Aug	6.18	0.36	11.57	0.07	7.26	1.28	26.72
Sep	6.14	0.35	11.48	0.07	7.21	1.27	26.52
Oct	6.01	0.35	11.25	0.07	7.06	1.25	25.99
Nov	6.23	0.36	11.66	0.07	7.32	1.29	26.93
Dec	5.98	0.34	11.18	0.07	7.02	1.24	25.83
Jan	6.19	0.36	11.58	0.07	7.27	1.28	26.75
Feb	6.18	0.36	11.57	0.07	7.26	1.28	26.72
Mar	6.22	0.36	11.64	0.07	7.30	1.29	26.88
Apr	6.20	0.36	11.61	0.07	7.28	1.29	26.81
May	6.18	0.36	11.57	0.07	7.26	1.28	26.72
Jun	6.22	0.36	11.63	0.07	7.30	1.29	26.87
Total	73.94	4.28	138.35	0.84	86.83	15.33	319.57

Generated electricity = 70.59 in kWh

Total non-fuel or operation and maintain cost = 26.82 MTk

Per unit won-fuel or 0 and M cost = $\frac{\textbf{Non-Fuel Cost MTk}}{\textbf{Generated Electricity MkWh}}$

$$= \frac{26.82\ \text{MTk}}{70.59\ \text{MkWh}}$$

$$= 3.07\ \text{Tk/ kWh}$$

6.3.3: Chart of cost

Table No. 6.2.7: Chart of cost

Chart of Cost									
Month	***plant factor %***	***Heat Rate (kCal/ kWh)***	***Total Fuel Cost (MTk)***	***Per Unit Fuel Cost (Tk/kWh)***	***Fixed Cost (MTk)***	***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	42.17	21118.57	2.46	0.03	186.76	26.83	0.38	216.47	3.07
Aug	42.11	21093.19	2.46	0.03	186.76	26.72	0.38	216.35	3.07
Sep	41.88	21108.27	2.45	0.03	186.76	26.52	0.38	216.14	3.08
Oct	41.76	21115.88	2.44	0.03	186.76	25.99	0.37	215.59	3.08
Nov	41.70	21040.40	2.43	0.03	186.76	26.93	0.39	216.53	3.10
Dec	41.46	20151.44	2.31	0.03	186.76	25.83	0.37	215.31	3.10
Jan	42.00	21258.18	2.47	0.03	186.76	26.75	0.38	216.39	3.08
Feb	41.82	21085.71	2.44	0.03	186.76	26.72	0.38	216.33	3.09
Mar	42.17	20383.85	2.38	0.03	186.76	26.88	0.38	216.43	3.07
Apr	41.28	21467.15	2.45	0.03	186.76	26.81	0.39	216.44	3.13
May	41.64	21441.18	2.47	0.03	186.76	26.72	0.38	216.36	3.10
Jun	41.25	21375.81	2.44	0.03	186.76	26.87	0.39	216.49	3.14

6.3.4: Tariff Rate

The Bangladesh Energy Regulatory Commission (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 following

Table No. 6.2.8: Tariff Rate

SL	Customer Category		Per Unit Rate (Tk.)
1	Category-A : Residential		
	a.	First Step : From 000 to 100 units	**2.60**
	b.	Second Step : From 101 to 400 units	**3.30**
	c.	Third Step : From 401 to above	**5.65**
2	Category-B : Agricultural pumping		**1.93**
3	Category-C : Small Industries		
	a.	Flat Rate	**4.35**
	b.	Off-Peak Time	**3.50**
	c.	Peak Time	**5.95**
4	Category-D : Non-Residential (Light & Power)		**3.35**
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**

6.3.5: 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 to wed 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.

[Ref. www.powerdivision.gov.bd]

CHAPTER 7
CONCLUSION

7.1: Conclusion

Electricity tariff is an important subject in our country. It is related with our economic progress. 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 decrease fuel cost of generation. Although natural gas is insufficient in our country. So, we should make public consciousness about waste of our natural gas. Our government should take step for development our power station. In our power station, generators efficiency rate is low. It should be rise 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 only 47% of the total population has access to electricity and per capita generation is only 182 kWh, which are very low compared to other developing countries. The Government has given outmost priority to power sector expansion 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 insufficient end-use consumer 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.

Dement of the quality of power supply to end- use consumers' needs to be attained fast to advance acceptance of tariff growths. 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.

To conclude a decision should 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 2010 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: Work Limitations

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: Electric Safety at Home:

Safety procedures & standards for home are mentioned below:

- Use BSTI approved conductor & equipment for house wiring purpose.
- All circuits are to be protected by proper fuse/C.Bs.
- All house hold equipment's like freeze, oven, Television, Computer etc. should be properly grounded.
- All switches are to be installed on phases of the supply line.
- A two pole main switch for single phase & a four pole main switch for 3 phase supply is too installed.
- The alternate generator supply is to be installed through a change over switch of proper rating.
- Switch is not to be operated with wet hands.
- The house construction is to be such that it is at a safe distance from nearby electrical overhead lines.
- Tree plantation is to be such that it is clearly away from the overhead lines.

[Ref.www.bangladesh.gov.bd/Electricity]

7.4: Future Outline:

Tariff rate of electrical power depends on producing cost and transmission distribution cost. If producing cost and transmission distribution cost are high then electrical tariff rate will high and vice-versa. We discussed about producing cost, how to compute producing cost with example. We also argued about the significant terms that which are accountable for high producing cost. Anyone can work to analyze the transmission and distribution cost. Attentive people can study to estimate the producing cost for a high capacity electric power plant. And also can study to compute the transmission and distribution cost. If anyone can compute the transmission and distribution cost then he will be able to analyze the tariff rate.

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