



DAFFODIL INTERNATIONAL UNIVERSITY

THESIS PAPER

ON

**“TARIFF CALCULATION OF ELECTRIC POWER
(GENERATING COST CALCULATION “SYLHET 150 MW”)”**

Supervisor

Dr. Shamsul Alam
Professor and Dean
Faculty of Engineering

Prepared By

Md.Takmilul Islam
ID:111-33-507

Department of EEE
Daffodil International University

APPROVAL

This thesis titled “**Tariff calculation of electric power (Generating cost calculation Sylhet 150 MW)**”, submitted by **Md.Takmilul Islam** to the Department of Electrical and Electronics Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. Electrical and Electronics Engineering and approved as to its style and contents. The presentation has been held on

BOARD OF EXAMINERS

ProfessorDr. Shamsul Alam

Dean

Facultyof Engineering

DECLARATION

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

Supervised by :

Professor Dr. Shamsul Alam

Dean

Faculty of Engineering

Daffodil International University

Submitted by:

Md.Takmilul Islam

ID: 111-33-507

Department of EEE

Daffodil International University

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ABSTRACT

This thesis is on **“Tariff Calculation of Electric Power (Generating cost calculation)”**

The tariff structure would consist of two parts. In the solicited bids, the bidders shall offer bulk power tariff based on the capacity payment and energy payment and also provide the equivalent levelized tariff. The capacity payment will be made in Bangladeshi currency (Taka). This will cover debt service, return on equity, fixed operation and maintenance cost, insurance and other fixed cost. The energy payment will be denominated in local currency to the extent to which the variable costs are in local currency. This will cover the variable costs of operation and maintenance, including fuel. Interconnection of IPP to transmission system: The power will be purchased from the IPP at a specified voltage and frequency at the outgoing terminal of the substation of the power plant. The cost of interconnecting facilities up to outgoing terminals of the private power project will be borne by the private power producers.

Severe power crisis compelled the Government to enter into contractual agreements for high-cost temporary solution, such as rental power and small IPPs, on an emergency basis, much of it diesel or liquid-fuel based. This has imposed tremendous fiscal pressure. With a power sector which is almost dependent on natural-gas fired generation (89.22%), the country is confronting a simultaneous shortage of natural gas and electricity. Nearly 400-800 MW of power could not be availed from the power plants due to shortage of gas supply. Other fuels for generating low-cost, base-load energy, such as coal, or renewable source like hydropower, are not readily available and Government has no option but to go for fuel diversity option for power generation.

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Chapter 1

1.1 Introduction

Power plays a great role wherever people lives and works in industry, agriculture, and transportation etc. The living standard and prosperity of a nation vary directly with increase in use of power. As technology is advancing the consumption of power is steadily rising. Sufficient and reliable source of electricity is a major prerequisite for a sustained and successful economic development effort and poverty reduction. In Bangladesh, 90 million of the populations out of 140 million do not have direct access to electricity and remaining 50 million people have access but reliable and quality power is still beyond their reach (BPDB, 2007). In order to achieve 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 growing demand. So it is not possible to ensure a constant supply of electric power to all consumers throughout the country. Moreover the demand is increasing day by day. So it is essential to set up more generating station for over demanding load. On the other hand, the existing power stations have lost their lifetime; they are not reliable for steady generation. So it has to be replaced old generating units in various power stations. Shortage of power is serious problem and strong barrier for the development of our country. GOV of Bangladesh has so many limitations to set up sufficient power station. The GOV has given top priority to development of the sector considering its importance in overall development of the country. The GOV 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 (136 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 66%), followed by oil, hydropower and coal.

Electricity is the major source of power for most of the country's economic activities. Bangladesh's installed electric generation capacity was 8525 MW in 2013;^[1] only three-fourth of which is considered to be 'available'. Only 40% of the population has access to electricity with a per capita availability of 136 kWh per annum. Problems in the Bangladesh's electric power sector include corruption in administration, high system losses, 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 (136 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 66%), followed by oil, hydropower and coal. Electricity is the major source of power for most of the country's economic activities. Bangladesh's installed electric generation capacity was 8525 MW in 2013;^[1] only three-fourth of which is considered to be 'available'. Only 40% of the population has access to electricity with a per capita availability of 136 kWh per annum. Problems in the Bangladesh's electric power sector include corruption in administration, high system losses, delays in completion of new plants, low efficiencies, erratic power supply, electricity theft, blackouts, and shortages of funds for power plant maintenance. Overall, the country's generation plants have been unable to meet system demand over the past decade.

(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 in 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 fixed rate. Besides that big industries produce 1200 MW electricity for their own use from which additional 88 MW is supplied to the national grid. At present nearly 63 percent of total electricity production is produced from public entities. BPDB alone produces 46 percent of total electricity production.

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

1.3 Use of different types of energy :

Natural Gas is used as primary energy in most of the existing power plants. 88 per cent 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 increase 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 insufficiency 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 evident that in the power sector the following issues are to be addressed with due importance at the moment

- Inadequacy of supply of electricity compared to demand
- Dependency on single energy (gas) for electricity generation
- Investment or participation of private sector in electricity generation is at the minimum
- 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 mitigation of the above mentioned problems are discussed 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 of achieving the following objectives for making the vision a reality:

The Following issues have been identified to reach the objectives

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

Increasing private sector participation to mobilize finance

- Matching supply and demand for electricity;
- To ensure energy security for all;
- To reduce the consumption of natural gas, thereby releasing gas for use as fertilizer, or to increase the use of coal for electricity production to release gas for alternative use;
- Finalization of the coal extraction plan;
- Reasonable cost-effective price policy for gas, coal and electricity, these being under government control;
- Energy mix for electricity generation;
- Energy conservation;
- Promotion of renewable;
- Efficiency of the power sector; 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 of 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 Objective of this thesis is to calculate the generating cost of an electric power station that is tariff calculation. The main objective is that, we will learn about tariff, how to calculate generating 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.

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 referred to as electricity pricing or the price of electricity) varies widely from country to country, and may vary significantly from locality to locality within a particular country. There are many reasons that account for these differences 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)

2.2.1 Basis of electricity rates :

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

The actual electricity rate (cost per unit of electricity) that a customer pays can often be heavily dependent on customer charges, particularly for small customers (e.g. residential users).

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

2.3 Electricity generation :

Electricity generation is the process of generating [electrical power](#) from other sources of [primary energy](#).

The fundamental principles of electricity generation were discovered during the 1820s and early 1830s by the British scientist [Michael Faraday](#). His basic method is still used today: **electricity is generated 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 [kinetic 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)

2.4 Electricity generation in Bangladesh:

Different types of power plants generate electricity and synchronize it with the national grid. There are some isolated diesel power stations at remote places and islands which are not connected 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 generated 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)

2.5 Important terms for Calculation:

Availability Factor: means the ratio of (a) the number of hours a generating unit is mechanically able to produce power in a given period to (b) the number of hours in the period. A factor less than 100% indicates planned or unplanned outages for maintenance. A plant's availability factor will be higher than its capacity factor, because a plant is not used in every hour it is available.

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

Commission: 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 1 hour.

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

Rate: 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)

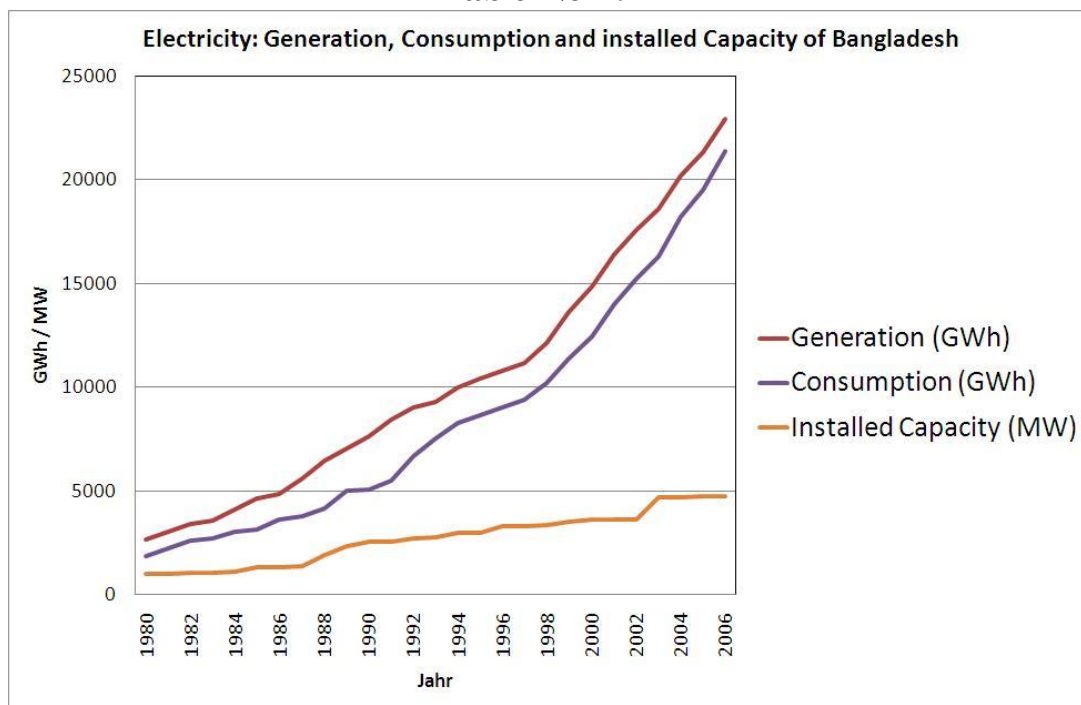
2.6 Electricity Situation at a glance:

Table No-2.1

Generation Capacity	8525 MW
Maximum Generation (on 04 August 2012)	6350 MW
Transmission Line	8949 Km
Distribution Line	281,123 Km
Distribution Loss	12%
Per Capita Electricity Generation (inuding captive generation)	292 kW-hr
Number of Cloents (connection wise)	13.64 million
Total Beneficiries	95.60 million
% of Population Getting Electricity (incl. renewable sources)	60%

[Ref.https://energypedia.info/wiki/Bangladesh_Energy_Situation#Electricity]

Table No-2.2



Chapter 3

Fuel cost calculation method

3.1 Fuel charge :

In electricity generation, fuel charge is the amount of cost that calculate for per unit generation.

Each generation unit shall have a two part tariff rate. One part will consist of the fuel cost involved in the generation of the electricity, and the other part will recover the plant's revenue requirement.

A customer's invoice or bill will indicate the fuel charge and the service charge for the month's consumption.

The customer's total charge will be the sum of these two amounts.

(Ref. Electricity generation tariff regulation from BERC)

Fuel Charge = Fuel Cost Recovery Rate x Customer's Consumption

Service Rate Charge = Service Rate x Customer's Consumption

3.2 Fuel cost recovery tariff rate:

Fuel Cost Recovery Rate means the rate charged which allows the generation company to recover the includable acquisition and delivery costs of fuel used for the generation of electricity. The purpose of the fuel cost recovery rate is to pass through to the customers the actual costs of generation of electricity, in direct response to changes in the market prices of fuel. The licensee will earn no profit or return on these costs. As fuel market prices change, the rates for fuel recovery will change on a semi-annual basis.

The fuel cost recovery rate shall be expressed on a taka per kilowatt-hour basis.

The numerator of the fuel component shall be equal to the includable acquisition and delivery costs of fuel for the generation of electricity. The denominator shall equal the corresponding number of includable net kilowatt-hours generated and sold.

(Ref. Electricity generation tariff regulation from BERC)

3.2.1 Includable acquisition and delivery costs of fuel :

This amount shall include the cost of fuel used in the generation of electricity.

In the case of natural gas, this will include the cost of natural gas, as charged by the natural gas supplier, as delivered through the plant meter.

In the case of coal, condensate, fuel oil, or other solid or liquid fuel, it would include the costs and expenses of unloading fuel from the shipping media and handling thereof up to the point where the fuel enters the first boiler plant bunker, hopper, bucket, tank or holder of the boiler-house structure.

In the case of biomass, the Commission will deal with this on a case-by-case basis.

In the case of hydroelectric, the Commission will not consider a fuel cost recovery rate, except in circumstances in which water is pumped to a reservoir for release through the hydroelectric system, and then the Commission will deal with this on a case-by-case basis for the costs attributable to the fuel costs of operating the pumping system.

In the case of solar or wind, the Commission will not consider a fuel cost recovery rate.

If a plant uses multiple fuel types, the fuel cost will be a weighted average based upon the net BTU content delivered through the combustion process.

Records shall be maintained to show the quantity, BTU content, and cost of each type of fuel used, where applicable.

Licensees shall routinely inventory any stored fuels such as coal or fuel oil, and where purchase records list amounts that are greater than actual inventories, the records for purposes of the fuel cost recovery charge shall be reduced to reflect actual inventory amounts.

For accounting purposes, the sub-accounts used to support costs and expenses identified above are as follows. If included in the fuel cost recovery factor, they are not eligible to be included in the service tariff rate as an operating expense. These expenses are only included for those activities performed by generation employees, or generation licensee contract services.

3.2.2 Labour relating to:

All routine fuel analyses.

- Unloading from shipping facility and putting in storage.
- Moving of fuel in storage and transferring fuel from one station to another.
- Handling from storage or shipping facility to first bunker, hopper, bucket, tank or holder of boiler-house structure.

- Operation of mechanical equipment, such as locomotives, trucks, cars, boats, barges, cranes, etc.

3.2.3 Materials and Expenses relating to:

- Operating, maintenance and depreciation expenses of licensee-owned transportation equipment used to transport fuel from the point of acquisition to the unloading point.
- Lease or rental costs of transportation equipment used to transport fuel from the point of acquisition to the unloading point.
- Cost of fuel including freight, switching, demurrage and other transportation charges.
- Excise taxes, insurance, purchasing commissions and similar items.
- Stores expenses to extent applicable to fuel.
- Transportation and other expenses in moving fuel in storage.
- Tools, lubricants and other supplies.
- Operating supplies for mechanical equipment.
- Residual disposal expenses less any proceeds from sale of residuals.
- If included in the fuel cost recovery factor, these costs are not eligible to be included in the service tariff rate as an operating expense. These expenses are only included for those activities performed by generation employees, or generation licensee contract services.
- In computing this, the licensee will use the actual fuel costs and actual net generation to the best of its ability.

Where:

Actual Fuel Cost = Taka.

Net Generation = KWH

Fuel Recovery Rate = Taka/KWH

3.4 Important terms for calculation:

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.

A base load power plant with a capacity of 1,000 megawatts (MW) might produce 648,000 megawatt-hours (MW·h) in a 30-day month. The plant factor is 0.9 or 90%

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

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.

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 megajoules per cubic metre (MJ/m³).

3.5 Chart of calorific value of gas :

Gas passing through the National Grid pipeline system has a CV of 37.5 MJ/m³ to 43.0 MJ/m³, with the exception of Stornoway which receives liquid petroleum gas.

	Titas	Habiganj	Bakhrabad	Narsingdi	Meghna
Gross Calorific value of sales- gas(BTU/SCF)	1,032	1,014	1,047	1,038	1,044

3.6 How to calculate fuel cost :

At first, we have to calculate yearly net generation using the product of net capacity, plant factor and monthly operation hour. Then we calculate the the total heat required for generation using the product of yearly net generation and heat rate. After these, we have to calculate the total fuel required for net generation using total heat required for generation divided by calorific value of fuel(gas) .Finally we calculate the total fuel cost per year

generation using fuel price and total fuel required . We also calculate per unit(KWh) cost for all parameters. An example also given in chapter 5 .

Chapter 4

Service charge calculation method

4.1 Service tariff rate :

The Service Tariff Rate is intended to establish tariff rates which provide the least cost to consumers, and also provide the opportunity for the licensee to earn sufficient revenues to cover all of its operating expense, provide for continuing improvement of its operating system, and attract capital for investment.

The first element is establishing a test year. This is a standardized period. The applicant for a tariff rate compiles his data on the basis of this period. The Commission's analysis and decision is based upon the foundation of data produced for the test year.

The test year is a twelve month period for which complete data is available. Using this twelve months accumulation of data, the Commission staff will review the financial and economic analysis that supports the rate and tariff application to see if it is reasonable. The Commission hereby defines the test year, for the tariff rate case applications placed before it, as the most recent fiscal year ending on 30 June .

(Ref. Electricity generation tariff regulation from BERC)

4.2 Revenue Requirement :

The revenue requirement is the amount of revenue that represents a licensee's capital and operational costs. Essentially this is the cost of providing service to the customers. The Commission establishes it on the basis of the data provided by the applicant. This revenue target is the amount that the Commission believes the licensee should receive in the course of its operations. Establishing this target does not guarantee that the licensee will earn this amount, but only that it has the opportunity to earn this amount. Its ability to achieve this target, or even exceed it, is a function of the licensee's own management of its operations.

Total Annual Revenue Requirement = Return on Rate Base + Total Costs

(Ref. Electricity generation tariff regulation from BERC)

4.2.1 Rate Base or Qualifying Assets:

The rate base and the operating and maintenance expenses are the two significant cost factors in the design of Tariff Rates.

The rate base is the foundation used by the Commission in establishing the licensee's profit or return. The rate base is used to fundamentally develop a return on assets. However, the assets are qualified. The value established for Tariff Rate design purposes is the net book value of the assets (purchase minus depreciation), plus construction (capital) work in progress, and plus regulatory working capital. The return to be included in the revenue requirement is a percentage rate which is multiplied times the taka value of the rate base.

Rate Base = Used and Useful Assets + Approved Construction Work In Progress + Working Capital

Return on Rate Base = Rate Base × Rate of Return

(Ref. Electric generation Tariff methodology from BEREC)

4.2.2 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, and general plant.

(Ref. Electric generation Tariff methodology from BEREC)

Intangible plant: intangible plant would consist of organization, franchises and consents, and miscellaneous intangible plant.

Production plant: 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; and 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.

General plant: 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.

(Ref. Electric generation Tariff methodology from BERC)

4.2.3 Capital (Construction) Work In Progress:

In most licensee tariff rates, only assets which have been placed in service are included in the rate base. However, in the electric licensee industry, the costs of construction, and often the length of time to complete construction are much in excess of those incurred in other licensee utility services. Therefore construction (capital) work in progress (CWIP) is allowed. This CWIP means that, as portions of construction are completed, the amount of expense which represents that completed portion can be included in the total rate base for calculating return on assets.

4.3 Regulatory Working Capital :

The last major element of rate base 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, fuel inventory, materials and supplies inventory, and any prepayments made.

Regulatory Working Capital = Cash Working Capital + Fuel Inventory + Materials and Supplies Inventory + Prepayments

(Ref. Electric generation Tariff methodology from BERC)

4.3.1 Cash working capital :

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

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

Cash Working Capital = $1/6 \times (\text{Annual Operation \& Maintenance Expenses})$

(Ref. Electric generation Tariff methodology from BERC)

4.3.2 Fuel inventory :

Average fuel inventory balances during the year is used. This is fuel stocked on site at the generation plant, such as coal. Fuel inventory would not be considered for natural gas or hydroelectric fueled facilities. The fuel inventory balance shall be based on test year data and computed at actual purchase prices. The fuel inventory for twelve months is divided by six to compute an average value which covers a two month period. Two months of on-site fuel inventory under ordinary circumstances should provide a sufficient supply pending transportation of replacement fuel.

Fuel Inventory = Sum of 12 Months Fuel Inventory / 6

(Ref. Electric generation Tariff methodology from BERC)

4.3.3 Materials and supplies inventory :

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

Materials and supplies inventory = $(\text{Total of 12 Months Value Materials and Supplies}) / 12$

(Ref. Electric generation Tariff methodology from BERC)

4.3.4 Prepayments:

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

Advanced income tax is a prepayment included in regulatory working capital. Advanced Income Tax is charged at the rate of 2.5% of the invoice value of the imported item, and also paid each quarter to the Government on the basis of regularly adjusted quarterly estimates. For regulatory working capital purposes, the licensee can receive a return on a portion of the advance income tax paid. The licensee shall divide advance income tax paid during the test year by 12 months to develop an amount that is included in regulatory working capital.

Prepayments = One Average Year of Pre-paid Items / 12

(Ref. Electric generation Tariff methodology from BEREC)

Exmple

Regulatory Working Capital for Generation

Cash working capital

(One-sixth of operation and maintenance expense,
excluding fuel)

2,586,360,000 Taka

Fossil Fuel Inventory (Coal)

3,580,740,000 Taka

Materials and Supplies

2,122,140,000 Taka

prepayments

45,000,000 Taka

Total Regulatory Working Capital

8,334,240,000 Taka

4.4 Return on Assets :

The Return on Qualifying Assets (or Rate Base) is the amount of the return, when included in Tariff Rates, that represent the licensee's opportunity to earn income on the part of the assets, in order to provide dividends to investors, and retained earnings to the company. In the case of government owned utilities, the emphasis is upon retained earnings. The licensee receives a return on qualifying rate base assets through tariff rates. The overall amount of the return within the tariff shall be determined according to the following basic formula:

Amount of Return = Qualifying Rate Base Assets x Rate of Return.

The qualifying assets of the licensee include the net book value of the used and useful assets, plus the regulatory working capital, which is required to provide the services. In addition, generation licensees may include completed work orders for major construction (capital) work in progress.

Net Book Value = Used and Useful Original Assets Value – Accumulated Depreciation

Qualifying Assets = Net Book Value of Assets + Regulatory Working Capital +

Construction (Capital) Work In Progress (Generation)

(Ref. Electric generation Tariff methodology from BEREC)

4.4.1 Tariff Rate of Return :

The tariff rate of return shall be approved by the Commission, in the process of consideration of tariff applications, according to the criteria stipulated in this regulation.

The licensee rate of return on qualifying assets shall be calculated as the weighted average cost of capital in accordance with the following formula:

Rate of Return =

$$\frac{(\text{Equity Capital} \times \text{Equity Rate}) + (\text{Debt Capital} \times \text{Debt Rate})}{(\text{Equity Capital} + \text{Debt Capital})}$$

(Ref. Electric generation Tariff methodology from BEREC)

4.5 Return on Equity:

The return on equity represents investors' 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.

4.5.1 Return on Debt :

$D\% =$

$$\frac{[(\text{Long Term Debt} \times \text{Debt Rate}) + (\text{Preferred Stock Amount} \times \text{Dividend Rate})]}{[(\text{Long Term Debt} + \text{Preferred Stock Amount})]}$$

$$[(\text{Long Term Debt} + \text{Preferred Stock Amount})]$$

Where $D\% = \text{Debt Rate}$

If there are multiple long term debt instruments at different interest rates, or multiple issuances of preferred stock at different dividend rates exist, then a similar weighted cost calculation would be performed for each category.

In terms of long term debt rate, the utilities that are wholly owned government entities shall use the loan rate applied by the government of Bangladesh, even if the loan funds derive from donor loans at a lower rate.

For a government owned enterprise, which does not pay a preferred stock dividend, the return on debt calculation defaults to an average of the long term debt, unless at some future date the government establishes the licensee as an independent joint stock company and the government receives a preferred stock dividend.

Example for government owned licensee:

For the government owned generation licensee, then the formula listed above for the debt rate becomes:

$$D\% = \frac{[(\text{Long Term Debt} \times \text{Debt Rate})]}{[(\text{Long Term Debt})]}$$

Since the licensee will have long term debt rates at different levels, a weighted average of all the loans will produce the debt rate. For example:

$$D\% = \frac{(21,000,000,000 \times 0.05) + (8,000,000 \times 0.0765) + (2,000,000,000 \times 0.08)}{(21,000,000,000 + 8,000,000 + 2,000,000,000)} = 0.0657$$

Where the 21,000,000,000 is the total of all loan amounts at 5% interest rate ; 8,000,000 total at 7.65%; and 2,000,000,000 total at 8%.

The result is a weighted debt rate of 6.57%. The loan amounts used in this calculation should represent the outstanding balance (or unpaid balance) of the loan – not the original loan amount.

(Ref. Electric generation Tariff methodology from BEREC)

4.6 Overall Tariff Rate of Return:

The fundamental formula for computing the Tariff Rate of return, as shown in the generic section of this regulation, would be applicable for an independently owned or a government owned generation company:

$$\text{Tariff Rate of Return} = \frac{[(\text{Equity Capital} \times E\%) + (\text{Debt Capital} \times D\%)]}{[(\text{Equity Capital} + \text{Debt Capital})]}$$

As an example for a government owned generation licensee, the following sample calculation would apply:

$$\text{Tariff Rate of Return} = \frac{[(4,000,000,000 \times 0.0670) + (23,008,000,000 \times 0.0657)]}{[(4,000,000,000 + 23,008,000,000)]} = 0.0659$$

Thus the rate of return to be applied to the asset base is 6.59%, which represents this licensee's weighted cost of capital.

This rate of return should provide the licensee with the opportunity to earn a return on the investment in the company, which is reasonable based upon its obligations for long term debts and its ability to raise capital.

(Ref. Electric generation Tariff methodology from BERC)

4.7 Total costs :

Total Costs are the sum of costs associated with the operation and maintenance (O & M) of the licensee's system, the straight-line depreciation costs of used and useful assets used for distribution for the Tariff Rate year, taxes, and any other necessary costs related to the operation of the licensee's system.

Total Costs = O&M Costs + Depreciation + Income & Other Taxes

4.7.1 Operation and Maintenance Expenses or Costs:

O & M costs are the expenses incurred in a business arising from or directly related to producing the service as well as the costs of maintaining the system in service.

Expenses included in the Fuel Cost Recovery Tariff Rate cannot be included in operation and maintenance expenses for the development of the service Tariff Rate.

(Ref. Electric generation Tariff methodology from BERC)

4.7.2 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.

The depreciation is returned to the natural monopoly, as part of the cash flow, along with the return on assets.

Cash Flow = Return on Assets + Depreciation

(Ref. Electric generation Tariff methodology from BERC)

4.7.3 Income and Other Taxes :

A licensee's taxes are an expense that should be recoverable as a business cost in providing regulated service. Three taxes directly affect a generator licensee's operations in Bangladesh – value added tax (VAT), land tax, and income tax.

To the extent that licensee makes payroll or invoice deductions from employee or contractor payments, for payment to the government, these are not included in the licensee's cost of service for Tariff Rate design purposes. To the extent that the

licensee provides matching payments to these deductions above the amount collected, then these are booked as an expense as part of the cost of service. If the licensee makes any other tax payments not already discussed in this methodology that has a direct result on the generation of electricity, then these are booked as an expense as part of the cost of service.

VAT is only collected at the distribution level and not collected on sales by the generation licensee to transmission or distribution licensees.

If the licensee pays VAT on any item it purchases, it is included in the book cost of that asset or item as part of the acquisition cost of the item for Tariff Rate design purposes.

Land tax is not directly affected by the amount of generation and generally is booked as a miscellaneous cost.

Income tax is charged as follows: for company which is not publicly traded the rate is 40% ; and a publicly traded company has a rate of 30%.

The amount of income tax to be included as a cost expense for Tariff Rate design during the test year is the actual amount of income tax paid to the Bangladesh government as booked for the test year.

At the time of importing materials to Bangladesh, the licensee pays a VAT, a Customs Duty, and Advanced Income Tax. Advanced Income Tax is charged at the rate of 2.5% of the invoice value of the imported item.

(Ref. Electric generation Tariff methodology from BEREC)

4.8 Recommended Total Annual Revenue Requirement:

The recommended revenue requirement would be the sum of the proposed return on rate base plus the total

operating expenses which includes the current year depreciation, and taxes for the test year.

Recommended Annual Revenue Requirement = Proposed Return on Rate Base + Operating Expenses

This amount is compared to the current operating revenues to determine the amount of the increase that will need to be obtained to allow the generation licensee to receive the revenue requirement.

4.8.1 Total Current Operating Revenues :

The total current operating revenues would be the sum of generation service revenues, income from other services rendered, any interest income, and any miscellaneous income.

Total Current Operating Revenues = Generation + Other Service + Interest + Miscellaneous

4.8.2 Proposed Revenue Increase :

The proposed revenue increase is the difference between the current revenues and the recommended operating revenue requirement. This difference is the amount of revenue that rates would need to be increased to provide the licensee with the opportunity to achieve the recommended rate of return and receive sufficient funds to cover operating expenses.

Proposed Revenue Increase = Recommended Operating Revenues - Current Revenues

This proposed revenue increase is going to be subject to income tax. If this proposed increase is directly added to current revenues, then the licensee after implementing the increase would not receive the recommended operating revenues. Future revenues would be reduced by the amount of the increased taxes. To insure the licensee receives the revenues recommended, the amount of the increase is “grossed up”. Essentially, the increase is enlarged to allow for the increased taxation. A revenue conversion factor is developed which is multiplied times the increase.

The revenue conversion factor is calculated by computing a formula. The formula is the number “1”, divided by the number “1” minus the effective income tax rate.

Revenue Conversion Factor = 1/(1 - Income Tax Rate)

Once the conversion factor has been developed, the amount of the increase is multiplied times the proposed revenue increase to develop a recommended revenue increase.

Recommended Revenue Increase = Proposed Revenue Increase * Revenue Conversion Factor

(Ref. Electric generation Tariff methodology from BEREC)

4.8.3 Total Recommended Revenue Requirement :

The total recommended revenue requirement is the sum of the current revenues plus the recommended revenue increase.

Recommended Revenue Requirement = Total Current Revenues + Recommended Revenue Increase

4.8.4 Generation Service Tariff Rate :

The generation service tariff rate is simply computed by dividing the recommended revenue requirement by the annual net generation by the plant in kilowatt hours for the test year.

Generation Service Tariff Rate = Recommended Revenue Requirement/Net Generation

4.8.5 Overall tariff rate:

The overall amount charged a generation customer will be the sum of the fuel cost recovery rate multiplied by the consumption and the generation service tariff rate multiplied times the consumption . All bills for customers will separately list the fuel cost and the service charges.

Overall Amount Charged Customer = (Fuel Cost Recovery Rate * KWH Delivered to Transmission) + (Service Tariff Rate * KWH Delivered to Transmission).

(Ref. Electric generation Tariff methodology from BEREC)

Chapter 5

Tariff Calculation

5.1 Tariff calculation method:

Each generation unit shall have a two part tariff rate. One part will consist of the fuel cost involved in the generation of the electricity, and the other part will recover the plant's revenue requirement.

A customer's invoice or bill will indicate the fuel charge and the service charge for the month's consumption.

Fuel Charge = Fuel Cost Recovery Rate x Customer's Consumption

Service Rate Charge = Service Rate x Customer's Consumption

The customer's total charge will be the sum of these two amounts.

For tariff calculation of Electric power, we have to calculate following terms:

1. Fuel cost/charge

- I. Yearly net generation
- II. Fuel required
- III. Fuel cost per unit/kwh

2. Service charge

- I. Operation & Maintenance cost
- II. Yearly Depreciation
- III. Regulatory Working Capital
- IV. ECA loan calculation
- V. Commercial loan Calculation
- VI. Return on Equity Calculation

5.2 Assumption data:

For tariff calculation of a Sylhet 150MW combined cycle power plant, assumption data is given in below:

Table No-5.1

SL NO	Parameter/Assumption/Boundary Condition		Unit
1	Net Capacity of the Power Plant	150	MW
2	Monthly Operation Hour	703.15	Hours
3	Plant Factor	61.06%	%
4	Yearly Net Generation	772,0587,00	kWh
5	Net Heat Rate	12687.13	KJ/kWh
6	Fuel (Gas) Price	79.82	Taka/MCF
7	Fixed Operation & Maintenance Cost (Tk/KW/Month)	178.1367	TK/kW/Month
8	Variable Operation & Maintenance Payment (VOMP)/Lub Oil Cost	0.09	Tk/kWh
9	Equity	30%	%
10	Debt (70% of total Rate Base)	70%	%
11	Foreign/ECA Loan Facilities: 60% of Total Debt	60%	%
12	Local/Commercial Loan Facilities: 40% of Total Debt,	40%	%
13	Working Capital Loan Facilities :70% of Total Regulatory Working Capital)	70%	%
14	Return on Equity	15.00%	%
15	Rate of Interest of Debt:		
16	Rate of Interest of Foreign/ECA Loan Facilities	8.00%	%
17	Rate of Interest of Local/Commercial Loan Facilities	16.00%	%
18	Rate of Interest of Working Capital Loan Facilities	16.00%	%
19	Average Rate of Interest	11.27%	%
20	Effective Plant Life	15	Years
21	Loan Repayment (1 Year Grace Period and Quarterly Installment)	10	Years
22	Corporate Income Tax	Nil	
23	Salvage Value	5%	%

Table No-5.2

PROJECT COST FOR Sylhet 150 MW GAS BASED POWER PLANT				
SL. No.	Items	BDT	\$/kW	Share of Investment (%)
1.0	Intangible Plant: (1)	278595246		2.68%
2.0	Production Plant/Plant Machinery and Equipment:			
2.1	Plant and Machinery C&F, 11/33 KV Sub-Station, Power Evacuation Line, RMS	8619820074		82.92%
	Sub-Total:(2)			
3.0	General Plant:			
3.1	Land and Land Development	132020883		1.27%
3.2	Infrastructure (Building & Civil Works)	345125454		3.32%
3.3	Office Furniture and Equipments	10395345		0.10%
3.4	Laboratory Equipments	5197674		0.05%
3.5	Electric Equipments	5197674		0.05%
3.6	Transportation & Communication Equipments	70688346		0.68%
3.7	Miscellaneous Equipments	5197674		0.05%
3.8	Other Tangible Equipments	5197674		0.05%
3.9	Interest During Construction	431406819		4.15%
3.10	Contingencies	486502146		4.68%
	Sub-Total:(3)	1,496,929680		14.40%
	Total Project Cost: [1+2+3]	10395345009		100%

Table No- 5.3

Assumption	BDT
Total of 12 Months Value Materials and Supplies	32484240
One Average Year of Pre-paid Items	541403892

5.3 Fuel cost calculation :

$$\begin{aligned}
 \text{Net Generation per year} &= \text{capacity} \times \text{hours per year} \times \text{plant factor} \\
 &= 150 \times 1000 \times 703.15 \times 12 \times 0.61 \\
 &= \mathbf{772,0587,00 \text{ kWh}}
 \end{aligned}$$

Generation cost is the summation of fuel cost and non fuel cost.

Given that heat rate = 12687.13 kj/kwh

$$\begin{aligned} \text{Total heat required for generation} &= 7720,587,00 \times 12687.13 \\ &= 9.795209095 \times 10^{12} \text{ kj} \end{aligned}$$

Now,

$$\begin{aligned} \text{Fuel required for generation} &= 12.675 \times 772058700 \\ &= \mathbf{9,785,844,023 \text{ cft}} \end{aligned}$$

$$\text{Total cost} = 779779287 \text{ tk}$$

$$\begin{aligned} \text{Fuel cost per year} &= \frac{779779287}{9,785,844,023} \\ &= \mathbf{0.07968 \text{ tk}} \end{aligned}$$

Now, fuel cost per unit = 1.01 tk/kwh

Table No- 5.4

Fuel Required (Cft/kWh)	12.675
Fuel Required (Cft)	9,785,844,023
Fuel Cost (Taka/Cft)	0.07968
Fuel Cost (Taka)	779779287
Fuel Cost (Taka/kWh)	1.01

5.4 Service charge Calculation:

Assumed that, for 61.06% plant factor the reference Escalable capacity price is 178.1367 tk/KWh/month .

For service cost calculation we have to calculate following terms :

- I. Operation & Maintenance cost/ expenses
- II. Yearly Depreciation
- III. Regulatory Working Capital
- IV. ECA loan calculation
- V. Commercial loan Calculation
- VI. Return on Equity Calculation

5.4.1 Operation & Maintenance Expenses:

$$\begin{aligned} \text{Operation and maintenance cost} &= \text{capacity} \times \text{capacity price per month} \\ &= 150 \times 1000 \times 178.1367 \times 12 \\ &= \mathbf{320,646,060 \text{ Tk}} \end{aligned}$$

$$\begin{aligned} \text{Operation and maintenance cost per unit kwh} &= \frac{320,646,060}{772,0587,00} \\ &= \mathbf{0.41531 \text{Tk/k Wh}} \end{aligned}$$

Variable operation and maintenance payment:

Lube oil required = 0.30 Gram/kWh

Cost of lube oil = 315 Tk/litre

Now 1 litre lube oil = 1000×0.89 (Specific gravity)
= 890 Gram

$$\text{Now VOMP cost /KWh} = \frac{315 \times 0.30}{890} = \mathbf{0.1061 \text{ Tk/KWh}}$$

Variable operation and maintenance

$$\begin{aligned} \text{Payment for net generation} &= 0.1061 \times 772058700 \\ &= \mathbf{81915428.07 \text{ Tk}} \end{aligned}$$

- ❖ **Total operation & maintenance Expenses = 402561488.6Tk**
- ❖ **Total operation & maintenance Expenses per kWh = 0.52141 tk/kWh**

Table No- 5.5

Operation & Maintenance Expenses	
Operating and Maintenance Cost (TK/kWh)	0.41531
Operating and Maintenance Cost (Taka)	320,646,060
VOMP (TK/kWh)	0.1061
VOMP (Taka)	81915428.07
Total (Taka)	402561488.6
Total (Taka/kWh)	0.52141

5.4.2 Depreciation calculation:-

For Depreciation calculation we use Straight line method ,

The simplest and most commonly used depreciation method, straight line depreciation is calculated by taking the purchase or acquisition price of an asset subtracted by the salvage

value divided by the total productive years the asset can be reasonably expected to benefit the company.

In Straight line method,

$$\text{Annual depreciation rate} = \frac{p-s}{n}$$

1.Intangible plant:-

Investment (Taka), p = 278,595,246 Tk

Salvage value, s = 0.00%

Service life, n = 15 years

Using Straight line method,

$$\begin{aligned}\text{Annual depreciation rate} &= \frac{p-s}{n} \\ &= \frac{278,595,246 - 0}{15} \\ &= \mathbf{18573016 \text{ Tk}}\end{aligned}$$

Annual Depreciation rate for intangible plant = 18573016 Tk

2.Production plant:-

Investment, p = 8619820074 Tk

Salvage value, s = 5% of investment

$$= 0.05 \times 8619820074$$

$$= 430991003 \text{ Tk}$$

Service life, n = 15

Now,

$$\text{The Annual depreciation rate} = \frac{p-s}{n}$$

$$\begin{aligned}&= \frac{8619820074 - 430991003}{15} \\ &= \mathbf{545921938 \text{ Tk}}\end{aligned}$$

Annual Depreciation rate for production plant = 545921938 Tk

3.General plant:-

❖ **Land and land development rate** :- Investment = 132020883 Tk

Salvage value, s = 0.00%

Service life, n = 15 years

Annual Depreciation rate

$$= \frac{132020883 - 0}{15}$$

Annual Depreciation rate=8801392 tk

In these case, Assumed that Depreciation rate = 0.00%

❖ **Infrastructure**:- Investment = 345125454 Tk

Salvage value = 5% of investment

$$= 0.05 \times 345125454 = 17256272.7 \text{ Tk}$$

Service life, n = 15 years

Annual Depreciation rate

$$= \frac{345125454 - 17256272.7}{15}$$
$$= 21857945.42 \text{ Tk}$$

❖ **Office furniture and equipment**:-

Investment, p = 10395345 Tk

Salvage value, s = 5% of investment

$$= 0.05 \times 10395345 \text{ Tk}$$

$$= 519767.25 \text{ Tk}$$

Service life, n = 15 years

Annual Depreciation rate =

$$= \frac{10395345 - 519767.25}{15}$$
$$= 658371.85 \text{ tk}$$

❖ **Laboratory Equipments**:- Investment, p = 5197674 Tk

Salvage value, s = 5% of investment

$$= 0.05 \times 5197674$$

$$= 259883.7 \text{ tk}$$

Service life, n = 15 years

Annual Depreciation rate =

$$= \frac{5197674 - 259883.7}{15}$$
$$= 329186.02 \text{ Tk}$$

Electric equipments:- Investment, p = 5197674 Tk

Salvage value, s = 5% of investment

$$= 0.05 \times 5197674$$

$$= 259883.7 \text{ Tk}$$

Service life, n = 15 years

$$\text{Annual Depreciation rate} = \frac{5197674 - 259883.7}{15}$$
$$= 329186.02 \text{ Tk}$$

❖ **Communication Equipments:-** Investment, p = 70688346 Tk

Salvage value, s = 5% of investment

$$= 0.05 \times 70688346$$

$$= 3534417.3 \text{ tk}$$

Service life, n = 15 years

$$\text{Annual Depreciation rate} = \frac{70688346 - 3534417.3}{15}$$

$$= 4476928.58 \text{ Tk}$$

❖ **Miscellaneous Equipments:-** Investment, p = 5197674Tk

Salvage value, s = 5% of investment

$$= 0.05 \times 5197674$$

$$= 259883.7 \text{ Tk}$$

Service life, n = 15 years

$$\text{Annual Depreciation rate} = \frac{5197674 - 259883.7}{15}$$
$$= 329186.02 \text{ Tk}$$

❖ **Other tangible Equipments:-** Investment, p = 5197674Tk

Salvage value, s = 5% of investment

$$= 0.05 \times 5197674$$

$$= 259883.7 \text{ Tk}$$

Service life, n = 15 years

$$\text{Annual Depreciation rate} = \frac{5197674 - 259883.7}{15} = 329186.02 \text{ Tk}$$

❖ **Interest during construction:-** Investment, p = 431406819 Tk

$$\begin{aligned} \text{Salvage value, s} &= 5\% \text{ of investment} \\ &= 0.05 \times 431406819 \\ &= 21570340.95 \text{ Tk} \end{aligned}$$

Service life, n = 15 years

$$\begin{aligned} \text{Annual Depreciation rate} &= \frac{431406819 - 21570340.95}{15} \\ &= 27322431.87 \text{ Tk} \end{aligned}$$

❖ **Contingencies :-** Investment, p = 486502146 Tk

$$\begin{aligned} \text{Salvage value ,s} &= 5\% \text{ of investment} \\ &= 0.05 \times 486502146 \\ &= 24325107.3 \text{ Tk} \end{aligned}$$

Service life ,n = 15 years

$$\text{Annual Depreciation rate} = \frac{486502146 - 24325107.3}{15}$$

$$= 30811802.58 \text{ TK}$$

Total Annual depreciation of general plant = 95245616.58 Tk

$$\begin{aligned} \text{Now Total Yearly Depreciation} &= (18573016.4 + 545912438 + 95245616.58) \\ &= \mathbf{659731071 \text{ Tk}} \end{aligned}$$

[[Intangible plant Depreciation+Production plant Dep.+ General plant Dep.]]

Table No- 5.6
Depreciation Table

SL NO	Description	Investment (Taka)	Salvage Value (%)	Salvage (Taka)	Net amount (taka)	Service Life (Years)	Yearly Depreciation (Taka)
1	2	3				4	5
1	Intangible Plant	278595246	0.00 %		278595246	15	18573016.4
2	Production Plant	8619820074	5.00 %	430991003	8188829071	15	545921938
3	General Plant						
4	Land and Land Development	132020883	0.00 %	0.00	132020883	15	8801392.2
5	Infrastructure	345125454	5.00 %	17256272.7	327869171.3	15	21857945.42
6	Office Furniture and equipments	10395345	5.00 %	519767.25	9875577.75	15	658371.85
7	Laboratory Equipments	5197674	5.00 %	259883.7	4937790.3	15	329186.02
8	Electric Equipments	5197674	5.00 %	259883.7	4937790.3	15	329186.02
9	Communication Equipments	70688346	5.00 %	3534417.3	67153928.7	15	4476928.58
10	Miscellaneous Equipments	5197674	5.00 %	259883.7	4937790.3	15	329186.02
11	Other Tangible Equipments	5197674	5.00 %	259883.7	4937790.3	15	329186.02
12	Interest During Construction	431406819	5.00 %	21570340.95	409836478	15	27322431.87
13	Contingencies	486502146	5.00 %	243251073	243251073	15	30811802.58
	Sub Total of General Plant	1496929680		287171406	1209758273		95245617
	Total	10395345009		718162409	9677182590		659740571

5.4.3 Regulatory Working Capital:

Cash working Capital:

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.

$$\text{Cash Working Capital} = 1/6 \times (\text{Annual Operation \& Maintenance Expenses})$$

$$= 1/6 \times (402561488.6)$$

$$= 67093581.33 \text{ tk}$$

Materials & Supplies inventory:

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

$$\text{Materials and supplies inventory} = (\text{Total of 12 Months Value Materials and Supplies}) / 12$$

$$= 32484240 / 12$$

$$= 2707020 \text{ Tk/month}$$

$$= 18046.8 \text{ Tk/MW}$$

It is the monthly cost per MW

Prepayment:

Prepayments are made in advance of the period to which they apply and include items such as prepaid rents, insurance, and taxes. The amounts normally allowed are based on the same standards outlined above for fuel inventories and M&S inventories.

Prepayments = One Average Year of Pre-paid Items / 12

$$= 541403892/12$$

$$= \mathbf{45116991 \text{ tk/month}}$$

$$= 30077994 \text{ Tk/MW}$$

It is the monthly cost per MW

Table No- 5.7

Regulatory Working Capital	
Cash Working Capital (Taka)	67093581.33
Materials and supplies inventory (Taka/month)	2707020
Prepayment (Taka/month)	45116991
Total-RWC (Taka)	114917592.3

5.4.4 ECA Loan Calculation :

Given that , Loan/Debt amount is 70% of Used & Useful Asset = 10395345009×0.70

$$= 7276741500 \text{ Tk}$$

And ECA loan is 60% of debt amount that is ECA loan = 7276741500×0.60

$$= 4366044900 \text{ Tk}$$

Principal	p =	4366044900
Yearly interest rate,	r =	8%
Quarterly interest rate, (r/4) =		2%
Number of installments, n =		40

We Know,

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

$$\Rightarrow 4366044900 = A \times \left[\frac{1 - \frac{1}{(1+r)^n}}{r} \right]$$

$$\Rightarrow 4366044900 = A \times \left[\frac{1 - \frac{1}{(1+0.02)^{40}}}{0.02} \right]$$

$$\Rightarrow 4366044900 = A \times \frac{0.5471}{0.02}$$

$$A = 159,604,036.2 \text{ tk}$$

[Note : PVIFA- Present Value Interest Factor of Annuity

This method shortly termed as Annuity method.

Definition of PVIFA :

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

Table No- 5.8

Quarters	Principal Beginning (1)	Instalment (2)	Quarterly Interest (3)=(1)×(.02)	Principal Repayment (4)=(2)-(3)	Principal Ending (5)=(1)-(4)	Yearly Interest
1 st	4366044900	159604036.5	87320898	72283138.5	4293761762	
2 nd	4293761762	159604036.5	85875235.2	3 73728801.27	4220032960	
3 rd	4220032960	159604036.5	84400659.2	75203377.3	4144829583	
4 th	4144829583	159604036.5	82896591.6	6 76707444.84	4068122138	340493384
5 th	4068122138	159604036.5	81362442.7	6 78241593.74	3989880544	

6 th	3989880544	159604036.5	79797610.8 9	79806425.61	3910074119	
7 th	3910074119	159604036.5	78201482.3 7	81402554.13	3828671565	
8 th	3828671565	159604036.5	76573431.2 9	83030605.21	3745640959	315934967. 3
9 th	3745640959	159604036.5	74912819.1 9	84691217.31	3660949742	
10 th	3660949742	159604036.5	73218994.8 4	86385041.66	3574564700	
11 th	3574564700	159604036.5	71491294.0 1	88112742.49	3486451958	
12 th	3486451958	159604036.5	69729039.1 6	89874997.34	3396576961	289352147. 2
13 th	3396576961	159604036.5	67931539.2 1	91672497.29	3304904463	
14 th	3304904463	159604036.5	66098089.2 7	93505947.23	3211398516	
15 th	3211398516	159604036.5	64227970.3 2	95376066.18	3116022450	
16 th	3116022450	159604036.5	62320449	97283587.5	3018738862	260578047. 8
17 th	3018738862	159604036.5	60374777.2 5	99229259.25	2919509603	
18 th	2919509603	159604036.5	58390192.0 6	101213844.4	2818295759	
19 th	2818295759	159604036.5	56365915.1 7	103238121.3	2715057637	
20 th	2715057637	159604036.5	54301152.7 5	105302883.8	2609754754	229432037. 2
21 th	2609754754	159604036.5	52195095.0 7	107408941.4	2502345812	
22 th	2502345812	159604036.5	50046916.2 4	109557120.3	2392788692	
23 th	2392788692	159604036.5	47855773.8 4	111748262.7	2281040429	
24 th	2281040429	159604036.5	45620808.5 9	113983227.9	2167057201	195718593. 7
25 th	2167057201	159604036.5	43341144.0 3	116262892.5	2050794309	
26 th	2050794309	159604036.5	41015886.1 8	118588150.3	1932206159	
27 th	1932206159	159604036.5	38644123.1 7	120959913.3	1811246245	

28 th	1811246245	159604036.5	36224924.9 1	123379111.6	1687867134	159226078. 3
29 th	1687867134	159604036.5	33757342.6 7	125846693.8	1562020440	
30 th	1562020440	159604036.5	31240408.8	128363627.7	1433656812	
31 th	1433656812	159604036.5	28673136.2 4	130930900.3	1302725912	
32 th	1302725912	159604036.5	26054518.2 4	133549518.3	1169176394	119725406
33 th	1169176394	159604036.5	23383527.8 7	136220508.6	1032955885	
34 th	1032955885	159604036.5	20659117.7	138944918.8	894010966. 2	
35 th	894010966.2	159604036.5	17880219.3 2	141723817.2	752287149	
36 th	752287149	159604036.5	15045742.9 8	144558293.5	607728855. 5	76968607.8 7
37 th	607728855.5	159604036.5	12154577.1 1	147449459.4	460279396. 1	
38 th	460279396.1	159604036.5	9205587.92 2	150398448.6	309880947. 5	
39 th	309880947.5	159604036.5	6197618.95	153406417.5	156474530	
40 th	156474530	159604036.5	3129506.5	156474530	0	30687290.4 8
		63,84,161,46 0		201811656	4366044900	201811656 0

Return on ECA loan per year (sum of Yearly interest/10) =201811656 Tk

5.4.5 Commercial loan Calculation:

Given that , Loan/Debt is 70% of Used & Useful Asset = **10395345009**×0.70

$$= 7276741500 \text{ Tk}$$

Since the commercial loan is 40% of total debt amount,

Now the Commercial loan is = 7276741500×0.40 = 2910696600 Tk.

Principal	=	2910696600
Yearly interest rate, r	=	16%
Quarterly interest rate, (r/4)=	=	4%
Number of installments, n	=	40

We Know,

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

$$\Rightarrow 2910696600 = A \times \left[\frac{1 - \frac{1}{(1+r)^n}}{r} \right]$$

$$\Rightarrow 2910696600 = A \times \left[\frac{1 - \frac{1}{(1+0.04)^{40}}}{0.04} \right]$$

$$\Rightarrow 2910696600 = A \times \frac{0.791710}{0.04}$$

$$A = 147058548.6 \text{ tk}$$

[Note : PVIFA- Present Value Interest Factor of Annuity

This method shortly termed as Annuity method

Definition of PVIFA :

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

Table No- 5.9
Re-payment of Commercial/Local Loan

Quarters	Principal Beginning (1)	Instalment (2)	Quarterly interest (3)=(1)×(0.04)	Principal Repayment (4)=(2)-(3)	Principal Ending (5)=(1)-(4)	Yearly Interest
1st	2910696600	147058548.6	116427864	30630684.6	2880065915	
2nd	2880065915	147058548.6	115202636.6	31855911.98	2848210003	
3rd	2848210003	147058548.6	113928400.1	33130148.46	2815079855	
4th	2815079855	147058548.6	112603194.2	34455354.4	2780624501	458162094.9
5th	2780624501	147058548.6	111224980	35833568.58	2744790932	
6th	2744790932	147058548.6	109791637.3	37266911.32	2707524021	
7th	2707524021	147058548.6	108300960.8	38757587.77	2668766433	
8th	2668766433	147058548.6	106750657.3	40307891.28	2628458542	436068235.4
9th	2628458542	147058548.6	105138341.7	41920206.94	2586538335	
10th	2586538335	147058548.6	103461533.4	43597015.21	2542941319	
11th	2542941319	147058548.6	101717652.8	45340895.82	2497600424	
12th	2497600424	147058548.6	99904016.94	47154531.66	2450445892	410221544.8
13th	2450445892	147058548.6	98017835.68	49040712.92	2401405179	

14th	2401405179	147058548.6	96056207.16	51002341.44	2350402838	
15th	2350402838	147058548.6	94016113.5	53042435.1	2297360403	
16th	2297360403	147058548.6	91894416.1	55164132.5	2242196270	379984572.4
17th	2242196270	147058548.6	89687850.8	57370697.8	2184825572	
18th	2184825572	147058548.6	87393022.89	59665525.71	2125160046	
19th	2125160046	147058548.6	85006401.86	62052146.74	2063107900	
20th	2063107900	147058548.6	82524315.99	64534232.61	1998573667	344611591.5
21th	1998573667	147058548.6	79942946.69	67115601.91	1931458065	
22th	1931458065	147058548.6	77258322.61	69800225.99	1861657839	
23th	1861657839	147058548.6	74466313.57	72592235.03	1789065604	
24th	1789065604	147058548.6	71562624.17	75495924.43	1713569680	303230207
25th	1713569680	147058548.6	68542787.19	78515761.41	1635053918	
26th	1635053918	147058548.6	65402156.73	81656391.87	1553397527	
27th	1553397527	147058548.6	62135901.06	84922647.54	1468474879	
28th	1468474879	147058548.6	58738995.16	88319553.44	1380155326	254819840.1
29th	1380155326	147058548.6	55206213.02	91852335.58	1288302990	
30th	1288302990	147058548.6	51532119.6	95526429	1192776561	
31th	1192776561	147058548.6	47711062.44	99347486.16	1093429075	
32th	1093429075	147058548.6	43737162.99	103321385.6	990107689.2	198186558.1
33th	990107689.2	147058548.6	39604307.57	107454241	882653448.1	
34th	882653448.1	147058548.6	35306137.93	111752410.7	770901037.5	
35th	770901037.5	147058548.6	30836041.5	116222507.1	654678530.4	
36th	654678530.4	147058548.6	26187141.21	120871407.4	533807123	131933628.2
37th	533807123	147058548.6	21352284.92	125706263.7	408100859.3	
38th	408100859.3	147058548.6	16324034.37	130734514.2	277366345.1	
39th	277366345.1	147058548.6	11094653.8	135963894.8	141402450.3	
40th	141402450.3	147058548.6	5656098.011	141402450.6	0	54427071.1
		5882341944				2971645344
Return on Commercial loan per year(sum of Yearly interest/10) =297164534.4 Tk						

5.4.6 Equity Calculation:

Given that, Equity amount is 30% of total rate base.

Since total rate base is = 10510262601

Therefore, Equity amount = 10510262601 × 0.30 = 3153078780 tk

Principal	=	3153078780
Return on equity rate , r	=	15%
Effective plant life, n	=	15 years

We Know,

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

$$\Rightarrow 3153078780 = A \times \left[\frac{1 - \frac{1}{(1+r)^n}}{r} \right]$$

$$\Rightarrow 3153078780 = A \times \left[\frac{1 - \frac{1}{(1+0.15)^{15}}}{0.15} \right]$$

$$\Rightarrow 3153078780 = A \times \frac{0.877105514}{0.15}$$

$$A = 539,230,239.7 \text{ tk}$$

[Note : PVIFA- Present Value Interest Factor of Annuity

This method shortly termed as Annuity method

Definition of PVIFA :

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

**Table No- 5.10
Return on Equity**

No. of years	Principal Beginning (1)	Installment (2)	Yearly Interest (3)	Principal Repayment (4)=(2)-(3)	Principal Ending (5)=(1)-(4)
1 st	3153078780	539230239.8	472961817	66268422.8	3086810357
2 nd	3086810357	539230239.8	463021553.6	76208686.22	3010601671
3 rd	3010601671	539230239.8	451590250.6	87639989.15	2922961682
4 th	2922961682	539230239.8	438444252.3	100785987.5	2822175694
5 th	2822175694	539230239.8	423326354.1	115903885.7	2706271809
6 th	2706271809	539230239.8	405940771.3	133289468.5	2572982340
7 th	2572982340	539230239.8	385947351	153282888.8	2419699451
8 th	2419699451	539230239.8	362954917.7	176275322.1	2243424129
9 th	2243424129	539230239.8	336513619.4	202716620.4	2040707509
10 th	2040707509	539230239.8	306106126.3	233124113.5	1807583395
11 th	1807583395	539230239.8	271137509.3	268092730.5	1539490665
12 th	1539490665	539230239.8	230923599.7	308306640.1	1231184025
13 th	1231184025	539230239.8	184677603.7	354552636.1	876631388.8
14 th	876631388.8	539230239.8	131494708.3	407735531.5	468895857.3
15 th	468895857.3	539230239.8	70334382.5	468895857.3	0
Sum of Yearly Interest			=4935374817 Tk		
Return on Equity per year(Sum of Yearly Interest/15)=329024987.8 tk					

5.7 Details cost of service :

Table No- 5.11

Details Cost of Service	
Net Energy Generation/kWh	772058700
Generation Asset In Service	10395345009
Yearly Depreciation (Taka)	659740571
Accumulated Depreciation	0
Used & Useful Asset (Taka)	10395345009
Yearly Depreciation	
Intangible Plant(Taka)	18573016
Production Plant(Taka)	545912438
General Plant(Taka)	95245616
Total(Taka)	659731070
Fuel Required (Cft/kWh)	12.675
Fuel Required (Cft)	9785844023
Fuel Cost (Taka/Cft)	0.0796
Fuel Cost (Taka)	779779287
Fuel Cost (Taka/kWh)	1.01
Operation & Maintenance Expenses	
Operating and Maintenance Cost (TK/kWh)	0.4153
Operating and Maintenance Cost (Taka)	320646060
VOMP (TK/kWh)	0.1061
VOMP (Taka)	819115428
Total (Taka)	402561488
Total (Taka/kWh)	0.5214
Regulatory Working Capital	
Cash Working Capital (Taka)	67093581
Materials & Supplies Inventory (Taka/Month)	2707020
Prepayment (Taka/Month)	45116991
Total-RWC (Taka)	114917592
Rate Base(Used & Useful Asset + Total-RWC)(Taka)	10510262601
Debt Amount (70%)	

ECA Loan (Taka) (60% of Debt.)	4366044900
Commercial Loan (Taka) (40% of Debt.)	2910696600
Working Capital (Taka) (70% of total RWC)	80442314
Total Debt Amount (Taka)	7357183814

Equity Amount (30% of Rate Base)	3153078780
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Return on Debt (Interest)	
ECA Loan (Taka)	201811656
Commercial Loan (Taka)	297164534.4
Working Capital (Taka) (16% of WC)	12870770
Total (Taka)	511846960.4

Return on Equity (Taka)	329024987.8
-------------------------	--------------------

Return on Rate Base (total Return on debt.+Return on equity)	840871948.2
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[**Note :Accumulated depreciation** is the total amount of depreciation for a fixed asset that has been charged to expense since that asset was acquired and made available for use. The accumulated depreciation account is an asset account with a credit balance (also known as a contra asset account); this means that it appears on the balance sheet as a reduction from the gross amount of fixed assets reported. In these case, we assumed that accumulated Depreciation is zero since land property.]

5.6 Chart of cost of Sylhet 150MW gas based power plant :

Table No- 5.12

Costing for 150MW Gas Based Power Plant			
Details Cost Components of Energy Generation			
Cost Analysis:			
SL No	Description	Cost (Million Taka)	Tk/kWh
A	Fuel Cost Recovery Tariff Rate (FCRR)	779.779	1.01
B	Generation Service Tariff Rate (STR)		
1	Rate Base (RB)		
	Current Asset	10,395.34	
	Accumulated Depreciation	0.00	
	Regulatory Working Capital	114.91	
	Total Rate Base	10,510.2	
2	Return on Rate Base:		
	Interest on Debt	511.84	0.66
	Return on Equity	329.02	0.42
	Total Return on Rate Base	840.85	
3	Operating Expenses:		
	Operation & Maintenance	320.64	0.41
	Variable Operation & Maintenance Price (VOMP)/Lube Oil Cost	81.91	0.11
	Depreciation Expenses	659.73	0.85
	Total Operating Expenses	1062.28	
4	Annual Revenue Requirement for STR(return on Rate base+ Total Operating Expenses)	1903.13	
5	Yearly Net Energy Generation (kWh)	772.058	
6	Service Tariff Rate (STR)/Non-Fuel Cost		2.45
7	Overall Cost		3.46

Table No-5.13

Indicative Price:

A	Fuel Cost Recovery Tariff Rate (FCRR)	779.779	1.01
B	Generation Service Tariff Rate (STR)		

B-1	Fixed/Non Escalable Service Tariff Rate		
	Interest on Debt	511.83	0.66
	Return on Equity	329.03	0.42
	Depreciation Expenses	659.73	0.85
	Total Fixed Cost/Non Escalable Service Tariff Rate	1500.59	1.93
B-2	Variable/Escalable Service Tariff Rate		
	Fixed Operation & Maintenance	320.64	0.41
	Variable Operation & Maintenance Price (VOMP)/Lube Oil Cost	81.91	0.11
	Total Escalable Service Tariff Rate	402.55	0.52
C	Total Service Tariff Rate (STR)/Non-Fuel Cost	1903.16	2.45
D	Total Indicative Cost		3.46

Note : In case of Variable/Escalable Service Tariff Rate ,we include fixed Operation & Maintenance cost since salaries and spare parts can be varied.

5.7 Tariff Rate :

[Ref.www.desco.org.bd/ page=tariff-

rate-2]

This is for information of all concerned that in accordance with the BERC Order # BERC/ Tariff/ BST-05/ Bubo/2012/2441 , Dated: 20 September 2012, the new tariff rates with respect to retail sales of electricity of Dhaka Electric Supply Company Ltd. (DESCO) has been made effective in case of Electricity usages from 01 September 2012 as the followings :

SL	Customer Category	Per Unit Rate(Tk)
	Category-A : Residential	
	a. First Step : From 0 to 75 units	3.33
	b. Second Step : From 76 to 200 units	4.73
1	c. Third Step : From 201 to 300 units	4.83
	d. Fourth Step: From 301 to 400 units	4.93
	e. Fifth Step: From 401 to 600 units	7.98
	f. Sixth Step: Above 600 units	9.38
2	Category-B : Agricultural pumping	2.51

	Category-C : Small Industries	
3	a. Flat Rate	6.95
	b. Off-Peak Time	5.96
	c. Peak Time	8.47
4	Category-D : Non-Residential (Light & Power)	4.53
	Category-E : Commercial And Office	
5	a Flat Rate	9.00
	b Off-Peak Time	7.22
	c Peak Time	11.85
	Category-F : Medium Voltage, General Purpose (11 KV)	
6	a Flat Rate	6.81
	b Off-Peak Time	5.96
	c Peak Time	9.33
	Category-H : High Voltage, General Purpose (33 KV)	
7	a Flat Rate	6.48
	b Off-Peak Time	5.87
	c Peak Time	9.14
8	Category-J : Street Light and Water Pumps	6.48

5.8 Bill Explanation :

What all utility bills should contain?

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

- Your name and address
- Your customer account or reference number (always quote this when you contact your supplier)
- The name of your supplier and its contact details
- How much you need to pay (including any money owed from previous bills) and when you need to pay by

More detailed information

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

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

Chapter 6

6.1 Conclusion :

Electricity tariff is an important issue of our country . Because electricity tariff rate is related with our economic growth. When electricity tariff rate becomes high then poor people of our country suffers a lot . By thinking about them, electricity tariff rate of our country should be low . If we use natural gas as a fuel then we can reduce fuel cost of generation. Although natural gas is insufficient in our country. So, we should make public awareness about misuse of our natural gas . Our government should take step for improvement our power station . In our power station , generators efficiency rate is low . It should be increase 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 highest priority to power sector development in Bangladesh and is committed to making electricity available to all citizens by 2021. In this connection, the Government has initiated implementing reform measures in the power sector, including significant development programs of which this Project constitutes an important part.

After all, at present bangladesh power sector is in loss crisis. On a consolidated basis the losses from inadequate end-use customer tariffs are compensated from profits in the generation and transmission segment of the power sector. However, inadequate tariffs will, in the first place affect the distribution segment and lead there to a similar situation than the one prevailing today:

- despite all efforts to improve efficiency and performance, the distribution companies will not be in the position to collect sufficient money to pay for their operating expenses and their debt service;
- in consequence the upstream segments of the power sector (generation and distribution) will not receive sufficient money; which
- in turn will lead to a continuation of the maintenance backlog in the generation segment and even worse in delays in the financing of important investment in the enhancement and improvement of the system.

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

It is finally a decision to be taken by the Government to what extent a tariff increase can be enforced in Bangladesh given the present quality of supply. The financial projections show that even a gradual increase of tariffs with the objective to achieve full cost recovery in 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.

6.2 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 equipments 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 to be 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]

6.3 Future Outline :

Usually, Tariff rate of electrical power depends on generating cost and transmission distribution cost. If generating cost and transmission distribution cost are high then electrical tariff rate will be high and vice-versa. In this paper, we discussed about generating cost, how to calculate generating cost with example. We also discussed about the important terms that are responsible for high generating cost. Anyone can work to calculate the transmission and distribution cost. Interested people can study to calculate the generating cost for a high capacity electric power plant. And also can study to calculate the transmission and distribution cost. If anyone can calculate the transmission and distribution cost then he will be able to calculate the tariff rate.

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