



DAFFODILINTERNATIONALUNIVERSITY

THESIS PAPER

ON

**“TARIFF CALCULATION OF ELECTRIC POWER”(GENERATING
COST CALCULATION “ KATAKHALI, RAJSHAHI”50 MW)**

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APPROVAL

This thesis titled **Tariff Calculation of Electric Power (Generating Cost Calculation KATAKHALI, RAJSHAHI50 MW)** submitted by **Md. Al Amin Hossain and Rajib Chandra Roy** 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. ShamsulAlamProfessor& 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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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 (136kWh) 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 .

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

1.2 Electricity Generation Structure

Bangladesh Power Development Board (BPDB), Baghabari 50 MW Peaking Power Station Company Limited, 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 (oil) 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 Electrical Generation:

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 voltage 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)

2.3.1 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](#) fueled 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 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 BEREC Act, all IPP/SPP are required to obtain a license from the BEREC and have tariff rates charged-to-consumers approved by the BEREC.

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)

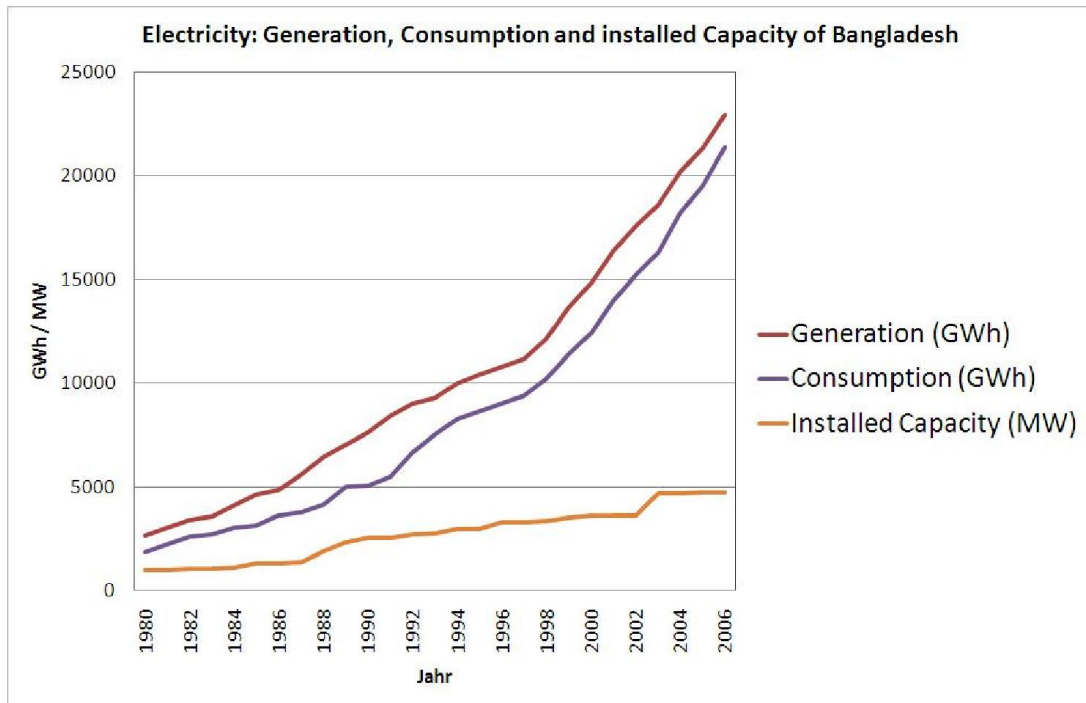
2.5 Electricity Situation at a glance:

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 (including 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 calculates 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 Labor 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 (MWh) 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 Oil: The CV of oil, gross and measured at standard conditions of temperature and pressure, is usually quoted in kilo caloric per Kilogram (Kcal/Kg)

3.5 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 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(Oil) .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 BEREC)

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 BEREC)

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 fuelled 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 = (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 prepaid 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 BERC)

Example

Regulatory Working Capital for Generation

Cash working capital

2,586,360,000 Taka

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

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 BERC)

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:

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

(Ref. Electric generation Tariff methodology from BERC)

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 :

$$D\% = \frac{[(\text{LongTermDebt} \times \text{DebtRate}) + (\text{PreferredStockAmount} \times \text{DividendRate})]}{[(\text{Long Term Debt} + \text{Preferred Stock Amount})]}$$

Where D%=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:

$$D\% = \frac{[(\text{LongTermDebt} \times \text{DebtRate})]}{[(\text{LongTermDebt})]}$$

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 BERC)

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:

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

$$[(4,000,000,000 + 23,008,000,000)]$$

$$= 0.0659$$

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 BERC)

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 BERC)

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 BERC)

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 Katakali 50MW Peaking 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	50 MW
2	Monthly Operation Hour (6 Engine)	628 Hours
3	Plant Factor	11.07% %
4	Yearly Net Generation	41,711,760 KWh
5	Efficiency	42.17% %
6	Heat Rate For HFO	39000 Kcal/kwh
7	Heat Rate For LFO	42200 Kcal/kwh
8	Load Factor	77.61% Taka/Gm
9	Fuel Required Per Unit	0.218 Litre/KWh
10	Fuel Cost Per Unit	13.29 Taka/KWh
	Operation & Maintenance Cost	
11	Fixed Operation & Maintenance Cost (Tk/KW/Month)	178.1367 TK/KW/Month
12	Variable Operation & Maintenance	0.09 Tk/KWh

	Payment (VOMP)/Lub Oil Cost		
13	Equity	30%	%
14	Debt (70% of Total Rate Base)	70%	%
14.1	Foreign/ECA Loan Facilities: 60% of Total Debt	60%	%
14.2	Local/Commercial Loan Facilities: 40% of Total Debt,	40%	%
14.3	Working Capital Loan Facilities :70% of Total Regulatory Working Capital)	70%	%
15	Return on Equity	15.00%	%
16	Rate of Interest of Debt:		
16.1	Rate of Interest of Foreign/ECA Loan Facilities	8.00%	%
16.2	Rate of Interest of Local/Commercial Loan Facilities	16.00%	%
16.3	Rate of Interest of Working Capital Loan Facilities	16.00%	%
16.4	Average Rate of Interest	11.27%	%
17	Effective Plant Life	15	Years
18	Loan Repayment (1 Year Grace Period and Quarterly Installment)	10	Years
19	Corporate Income Tax	Nil	
20	Salvage Value	5%	%

Table No-5.2

<u>PROJECT COST FOR 50 MW OIL BASED POWER PLANT</u>				
SL. No.	Items	BDT	\$/kW	Share of Investment (%)
1.0	Intangible Plant: (1)	92,865,082	22.65	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	2,873,273,358	700.80	82.92%
	Sub-Total:(2)			
3.0	General Plant:			
3.1	Land and Land Development	44,006,961	10.73	1.27%

3.2	Infrastructure (Building & Civil Works)	115,041,818	28.06	3.32%
3.3	Office Furniture and Equipments	3,465,115	0.85	0.10%
3.4	Laboratory Equipments	1,732,558	0.42	0.05%
3.5	Electric Equipments	1,732,558	0.42	0.05%
3.6	Transportation & Communication Equipments	23,562,782	5.75	0.68%
3.7	Miscellaneous Equipments	1,732,558	0.42	0.05%
3.8	Other Tangible Equipments	1,732,558	0.42	0.05%
3.9	Interest During Construction	143,802,273	35.07	4.15%
3.10	Contingencies	162,167,382	39.55	4.68%
	Sub-Total:(3)	498,976,560	121.70	14.40%
	Total Project Cost: [1+2+3]	3465115000	845.15	100%

3465115000	845.15	100.00%
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Table No- 5.3

Assumption	BDT
Total of 12 Months Value Materials and Supplies	10828080
One Average Year of Pre-paid Items	170595444

5.3 Fuel cost calculation :

$$\begin{aligned}
 \text{Net Generation per year} &= \text{capacity} \times \text{hours per year} \times \text{plant factor} \\
 &= 50 \times 1000 \times 628 \times 12 \times 0.1107 \\
 &= \mathbf{41,711,760 \text{ KWh}}
 \end{aligned}$$

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

Given that heat rate = 39000(HFO) Kj/litre

$$\begin{aligned}\text{Total heat required for generation} &= 41,711,760 \times 39000 \\ &= \mathbf{1.626 \times 10^{12} \text{Kj}}\end{aligned}$$

Again given heat rate for LFO = 42200 kj/litre

$$\begin{aligned}\text{Heat require for generation} &= 41,711,760 \times 42200 \\ &= \mathbf{1.760 \times 10^{12} \text{Kj}}\end{aligned}$$

$$\begin{aligned}\text{Total heat required for generation} &= \mathbf{1.626 \times 10^{12} + 1.760 \times 10^{12}} \\ &= \mathbf{3.386 \times 10^{12}}\end{aligned}$$

Fuel required per unit generation = 0.218 litre

$$\begin{aligned}\text{Fuel required for generation per year} \\ &= 41,711,760 \times \mathbf{0.218}\end{aligned}$$

= 9,093,163 litre

$$\begin{aligned}\text{Total fuel required per unit generation} &= \frac{\mathbf{9,093,163}}{\mathbf{41,711,760}} \\ &= \mathbf{0.217 \text{ Lit/KWh}}\end{aligned}$$

Fuel cost per unit = 13.29 TK

$$\begin{aligned}\text{Fuel cost per year} &= 41,711,760 \times 13.29 \\ &= \mathbf{554,349,290 \text{ Tk}}\end{aligned}$$

$$\text{Fuel cost (Tk/lit)} = \frac{\mathbf{554,349,290}}{\mathbf{9,093,163}} = \mathbf{60.96 \text{ Tk/lit}}$$

$$\text{Now, Fuel cost per unit} = \frac{\mathbf{554,349,290}}{\mathbf{41,711,760}} = \mathbf{13.29 \text{ Tk/KWh}}$$

Table No- 5.4

Fuel Required (Lit/KWh)	0.218
Fuel Required (Lit)	90,931,63
Fuel Cost (Taka/Lit)	60.96
Fuel Cost (Taka)	554,349,290
Fuel Cost (Taka/KWh)	13.29

5.4 Service charge Calculation:

For 70% plant factor the reference Escapable capacity price is 178.1367 Tk /KWh/Month .

For service cost calculation we have to calculate following terms :

1. Operation & Maintenance cost/expenses
2. Yearly Depreciation
3. Regulatory Working Capital
4. ECA loan calculation
5. Commercial loan Calculation
6. Return on Equity Calculation

5.4.1 Operation & Maintenance Expenses:

$$\begin{aligned}\text{Operation and maintenance cost} &= \text{Capacity} \times \text{Capacity price per month} \\ &= 50 \times 1000 \times 178.1367 \times 12 \\ &= \mathbf{106,882,020 \text{ Tk}}\end{aligned}$$

$$\text{Operation and maintenance cost per unit kwh} = \frac{106,882,020}{41,711,760} = \mathbf{2.562 \text{ Tk/KWh}}$$

Variable operation and maintenance payment:

Lube oil required = 0.35 Gram/KWh

Cost of lube oil = 300 Tk/Litre

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

$$\text{Now VOMP cost /KWh} = \frac{300 \times 0.35}{890} = \mathbf{0.1179 \text{ Tk/KWh}}$$

Variable operation and maintenance

Payment for net generation = $0.1061 \times 41,711,760 = \mathbf{4,425,617 \text{ Tk}}$

❖ **Total Operation & Maintenance Expenses = 111,307,637Tk**

❖ **Total Operation & Maintenance Expenses per KWh = 2.668Tk/KWh**

Table No- 5.5

Operation & Maintenance Expenses	
Operating and Maintenance Cost (TK/KWh)	2.562
Operating and Maintenance Cost (Taka)	106,882,020

VOMP (TK/KWh)	0.1061
VOMP (Taka)	4,425,617
Total (Taka)	111,307,637
Total (Taka/kWh)	2.668

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 = 92865082 Tk

Salvage value, s = 0.00%

Service life, n = 15 years

Using Straight line method,

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

$$= \frac{92865081-0}{15}$$

$$= 6191005 \text{ Tk}$$

Annual Depreciation rate for intangible plant = 6191005 Tk

2.Production plant:-

Investment, p = 2873223358 Tk

Salvage value, s = 5% of investment

$$= 0.05 \times 2873223358$$

$$= 143663668 \text{ Tk}$$

$$\text{Service life, } n = 15$$

Now,

$$\begin{aligned} \text{The Annual depreciation rate} &= \frac{p-s}{n} \\ &= \frac{2,873,223,358 - 143,663,668}{15} \\ &= 181,973,979 \text{ Tk} \end{aligned}$$

Annual Depreciation rate for production plant = 181,973,979 Tk

3.General plant:-

❖ **Land and land development rate:-** Investment, $p = 44,006,961 \text{ Tk}$

$$\text{Salvage value, } s = 0.00\%$$

$$\text{Service life, } n = 15 \text{ years}$$

$$\text{Annual Depreciation rate} = \frac{p-s}{n} = \frac{(44,006,961-0)}{15}$$

In these case, Assumed that Depreciation rate = 0.00%

❖ **Infrastructure:-** Investment = 115,041,818 Tk

Salvage value= 5% of investment

$$= 0.05 \times 115,041,818 = 5,752,091 \text{ Tk}$$

$$\text{Service life, } n = 15 \text{ years}$$

$$\begin{aligned} \text{Annual Depreciation rate} &= \frac{p-s}{n} = \frac{115,041,818 - 5,752,091}{15} \\ &= 7,285,982 \text{ Tk} \end{aligned}$$

❖ **Office furniture and equipment:-**

Investment, $p = 3,465,115 \text{ Tk}$

Salvage value, $s = 5\%$ of investment

$$= 0.05 \times 3,465,115 \text{ Tk}$$

$$= 173,256 \text{ Tk}$$

Service life, $n = 15 \text{ years}$

$$\begin{aligned} \text{Annual Depreciation rate} &= \frac{p-s}{n} = \frac{3,465,115 - 173,256}{15} \\ &= 219,457 \text{ Tk} \end{aligned}$$

❖ **Laboratory Equipments:-** Investment, $p = 1,732,358 \text{ Tk}$

Salvage value, $s = 5\%$ of investment

$$\begin{aligned}
 &= 0.05 \times 1,732,358 \\
 &= 86,628 \text{ Tk} \\
 \text{Service life, } n &= 15 \text{ years} \\
 \text{Annual Depreciation rate} &= \frac{(p-s)}{n} = \frac{1,732,358-86,628}{15} = 109,729 \text{ Tk}
 \end{aligned}$$

- ❖ **Electric equipments:-** Investment, $p = 1,732,558 \text{ Tk}$
 Salvage value, $s = 5\%$ of investment
 $= 0.05 \times 1,732,558$
 $= 86,628 \text{ Tk}$
 Service life, $n = 15 \text{ years}$

$$\begin{aligned}
 \text{Annual Depreciation rate} &= \frac{p-s}{n} = \frac{1,732,558-86,628}{15} \\
 &= 109,729 \text{ Tk}
 \end{aligned}$$

- ❖ **Communication Equipments:-** Investment, $p = 23,562,782 \text{ Tk}$
 Salvage value, $s = 5\%$ of investment
 $= 0.05 \times 23,562,782$
 $= 1,178,139 \text{ tk}$
 Service life, $n = 15 \text{ years}$

$$\begin{aligned}
 \text{Annual Depreciation rate} &= \frac{p-s}{n} = \frac{23,562,782-1,178,139}{15} \\
 &= 1,492,310 \text{ Tk}
 \end{aligned}$$

- ❖ **Miscellaneous Equipments:-** Investment, $p = 1,732,558 \text{ Tk}$
 Salvage value, $s = 5\%$ of investment
 $= 0.05 \times 1,732,558$
 $= 86,628 \text{ Tk}$
 Service life, $n = 15 \text{ years}$

$$\text{Annual Depreciation rate} = \frac{p-s}{n} = \frac{1,732,558-86,628}{15} = 109,729 \text{ Tk}$$

- ❖ **Other tangible Equipments:-** Investment, $p= 1,732,558$ Tk
 Salvage value, $s= 5\%$ of investment
 $=0.05 \times 1,732,558$
 $=86,628$ Tk
 Service life, $n= 15$ years

$$\text{Annual Depreciation rate} = \frac{p-s}{n} = \frac{1,732,558-86,628}{15}$$

$$=109,729 \text{ Tk}$$

- ❖ **Interest during construction:-** Investment, $p= 143,802,273$ Tk
 Salvage value, $s = 5\%$ of investment
 $= 0.05 \times 143,802,273$
 $=7,190,114$ Tk
 Service life, $n= 15$ years

$$\text{Annual Depreciation rate} = \frac{p-s}{n} = \frac{143,802,273-7,190,114}{15}$$

$$= 9,107,477 \text{ Tk}$$

- ❖ **Contingencies:-** Investment, $p= 162,167,382$ Tk
 Salvage value, $s= 5\%$ of investment
 $= 0.05 \times 162,167,382$
 $=8,108,369$ Tk
 Service life, $n= 15$ years

$$\text{Annual Depreciation rate} = \frac{p-s}{n} = \frac{162,167,382-8,108,369}{15} = 10,270,601 \text{ Tk}$$

Total Annual depreciation of general plant = 28,814,741 Tk

Now Total Yearly Depreciation = (6,191,005 + 181,973,979 + 28,814,741)
= 216,979,726 Tk

[[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	IntangiblePlant	92,865,082	0.00%		92,865,082	15	6,191,005
2	Production Plant	2,873,273,38	5.00%	143,663,668	2,729,609,690	15	181,973,979
3	General Plant						
	Land and Land Development	44,006,961	0.00%	0.00	44,006961	15	0.00
	Infrastructure	115,041,818	5.00%	5,752,091	109,289,727	15	7,285,982
	Office Furniture and equipments	3,463,115	5.00%	173,256	3,291,859	15	219,457
	Laboratory Equipments	1,732,558	5.00%	86,628	1,645,930	15	109,729
	Electric Equipments	1,732,558	5.00%	86,628	1,645,930	15	109,729
	Communication Equipments	23,562,782	5.00%	1,178,139	22,384,643	15	1,492,310
	Miscellaneous Equipments	1,732,558	5.00%	86,628	1,645,930	15	109,729
	Other Tangible Equipments	1,732,558	5.00%	86,628	1,645,930	15	109,729
	Interest During	143,802,273	5.00%	7,190,114	136,612,159	15	9,107,477

	Construction						
	Contingencies	162,167,382	5.00%	8,108,369	154,059,013	15	10,270,601
	Sub Total of General Plant	498,976,560		22,748,480	476,228,080		28,814,741
	Total	3,465,115,000		166,412,148	3,298,702,852		216,979,726

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.

Cash Working Capital = 1/6 × (Annual Operation & Maintenance Expenses)

=1/6 × (111,307,637)

=18,551,272 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.

Materials and supplies inventory = (Total of 12 Months Value Materials and Supplies) / 12

=10,828,080/12=902,340tk/month =18047 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

$$= 170,595,444/12$$

$$=14,216,287\text{Tk/Month}$$

$$=284,326\text{Tk/MW}$$

It is the monthly cost per MW

Table No- 5.7

Regulatory WorkingCapital	
Cash Working Capital (Taka)	18,551,272
Materials and supplies inventory (Taka/month)	9,02,340
Prepayment (Taka/month)	15,038,997
Total-RWC (Taka)	34,492,609

5.4.4 ECA Loan Calculation :

Given that , Loan/Debt amount is 70% of Used & Useful Asset = $3,465,115,000 \times 0.70$
 $= 2,425,580,500 \text{ tk}$

And ECA loan is 60% of debt amount that is ECA loan = $2,425,580,500 \times 0.60$
 $= 1,455,348,300 \text{ Tk}$

Principal	p =	1,455,348,300
-----------	-----	---------------

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

We Know,

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

$$\Rightarrow 1,455,348,300 = A \times \left[\frac{\{1 - \frac{1}{(1+r)^n}\}}{r} \right]$$

$$\Rightarrow 1,455,348,300 = A \times \left[\frac{\{1 - \frac{1}{(1+0.02)^{40}}\}}{0.02} \right]$$

$$\Rightarrow 1,455,348,300 = A \times \frac{0.5471}{0.02}$$

$$A = 53,201,345.41 \text{ tk}$$

[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	1,455,348,300	53,201,345	29,106,966	24,094,379	1,431,253,921	
2 nd	1,431,253,921	53,201,345	28,625,078	24,576,267	1,406,677,654	
3 rd	1,406,677,654	53,201,345	28,133,553	25,067,792	1,381,609,861	

4 th	1,381,609,861	53,201,345	27,632,197	25,569,148	1,356,040,713	113,497,795
5 th	1,356,040,713	53,201,345	27,120,814	26,080,531	1,329,960,182	
6 th	1,329,960,182	53,201,345	26,599,204	26,602,142	1,303,358,040	
7 th	1,303,358,040	53,201,345	26,067,161	27,134,185	1,276,223,856	
8 th	1,276,223,856	53,201,345	25,524,477	27,676,868	1,248,546,987	105,311,656
9 th	1,248,546,987	53,201,345	24,970,940	28,230,406	1,220,316,582	
10 th	1,220,316,582	53,201,345	24,406,332	28,795,014	1,191,521,568	
11 th	1,191,521,568	53,201,345	23,830,431	29,370,914	1,162,150,654	
12 th	1,162,150,654	53,201,345	23,243,013	29,958,332	1,132,192,321	96,450,716
13 th	1,132,192,321	53,201,345	22,643,846	30,557,499	1,101,634,822	
14 th	1,101,634,822	53,201,345	22,032,696	31,168,649	1,070,466,173	
15 th	1,070,466,173	53,201,345	21,409,323	31,792,022	1,038,674,151	
16 th	1,038,674,151	53,201,345	20,773,483	32,427,862	1,006,246,289	86,859,349
17 th	1,006,246,289	53,201,345	20,124,926	33,076,420	973,169,869	
18 th	973,169,869	53,201,345	19,463,397	33,737,948	939,431,921	
19 th	939,431,921	53,201,345	18,788,638	34,412,707	905,019,214	
20 th	905,019,214	53,201,345	18,100,384	35,100,961	869,918,253	76,477,346

21 th	869,918,253	53,201,345	17,398,365	35,802,980	834,115,273	
22 th	834,115,273	53,201,345	16,682,305	36,519,040	797,596,233	
23 th	797,596,233	53,201,345	15,951,925	37,249,421	760,346,812	

24 th	760,346,812	53,201,345	15,206,936	37,994,409	722,352,403	65,239,531
25 th	722,352,403	53,201,345	14,447,048	38,754,297	683,598,106	
26 th	683,598,106	53,201,345	13,671,962	39,529,383	644,068,722	
27 th	644,068,722	53,201,345	12,881,374	40,319,971	603,748,752	
28 th	603,748,752	53,201,345	12,074,975	41,126,370	562,622,381	53,075,360
29 th	562,622,381	53,201,345	11,252,448	41,948,898	520,673,483	
30 th	520,673,483	53,201,345	10,413,470	42,787,876	477,885,608	
31 th	477,885,608	53,201,345	9,557,712	43,643,633	434,241,974	
32 th	434,241,974	53,201,345	8,684,839	44,516,506	389,725,468	39,908,469
33 th	389,725,468	53,201,345	7,794,509	45,406,836	344,318,632	
34 th	344,318,632	53,201,345	6,886,373	46,314,973	298,003,660	
35 th	298,003,660	53,201,345	5,960,073	47,241,272	250,762,387	
36 th	250,762,387	53,201,345	5,015,248	48,186,098	202,576,290	25,656,203
37 th	202,576,290	53,201,345	4,051,526	49,149,820	153,426,470	
38 th	153,426,470	53,201,345	3,068,529	50,132,816	103,293,654	
39 th	103,293,654	53,201,345	2,065,873	51,135,472	52,158,182	
40 th	52,158,182	53,201,345	1,043,164	52,158,182	(0)	10,229,092

		2,128,053,816		1,455,348,300		672,705,516

Return on ECA loan per year(sum of Yearly interest/10) = 67,270,552 tk

5.4.5 Commercial loan Calculation:

Given that , Loan/Debt is 70% of Used & Useful Asset = $3,465,115,000 \times 0.70 = 2,425,580,500$ tk

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

Now the Commercial loan is = $2,425,580,500 \times 0.40 = 970,232,200$ Tk.

Principal	=	970,232,200
Yearly interest rate,r	=	16%
Quarterly interest rate, (r/4)=		4%
Number of installments, n	=	40

We Know,

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

$$\Rightarrow 970,232,200 = A \times \left[\frac{\{1 - \frac{1}{(1+r)^n}\}}{r} \right]$$

$$\Rightarrow 970,232,200 = A \times \left[\frac{\{1 - \frac{1}{(1+0.04)^{40}}\}}{0.04} \right]$$

$$\Rightarrow 970,232,200 = A \times \frac{0.791710}{0.04}$$

$$A = 49,019,516.20 \text{ tk}$$

[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
1 st	970,232,200	49,019,516	38,809,288	10,210,228	960,021,972	
2 nd	960,021,972	49,019,516	38,400,879	10,618,637	949,403,334	
3 rd	949,403,334	49,019,516	37,976,133	11,043,383	938,359,952	
4 th	938,359,952	49,019,516	37,534,398	11,485,118	926,874,834	152,720,698
5 th	926,874,834	49,019,516	37,074,993	11,944,523	914,930,311	
6 th	914,930,311	49,019,516	36,597,212	12,422,304	902,508,007	
7 th	902,508,007	49,019,516	36,100,320	12,919,196	889,588,811	
8 th	889,588,811	49,019,516	35,583,552	13,435,964	876,152,847	145,356,078
9 th	876,152,847	49,019,516	35,046,114	13,973,402	862,179,445	
10 th	862,179,445	49,019,516	34,487,178	14,532,338	847,647,106	
11 th	847,647,106	49,019,516	33,905,884	15,113,632	832,533,475	
12 th	832,533,475	49,019,516	33,301,339	15,718,177	816,815,297	136,740,515
13 th	816,815,297	49,019,516	32,672,612	16,346,904	800,468,393	
14 th	800,468,393	49,019,516	32,018,736	17,000,780	783,467,613	
15 th	783,467,613	49,019,516	31,338,705	17,680,812	765,786,801	
16 th	765,786,801	49,019,516	30,631,472	18,388,044	747,398,757	126,661,524
17 th	747,398,757	49,019,516	29,895,950	19,123,566	728,275,191	
18 th	728,275,191	49,019,516	29,131,008	19,888,509	708,386,682	

19 th	708,386,682	49,019,516	28,335,467	20,684,049	687,702,633	
20 th	687,702,633	49,019,516	27,508,105	21,511,411	666,191,222	114,870,531
21 th	666,191,222	49,019,516	26,647,649	22,371,867	643,819,355	
22 th	643,819,355	49,019,516	25,752,774	23,266,742	620,552,613	
23 th	620,552,613	49,019,516	24,822,105	24,197,412	596,355,201	
24 th	596,355,201	49,019,516	23,854,208	25,165,308	571,189,893	101,076,736
25 th	571,189,893	49,019,516	22,847,596	26,171,920	545,017,973	
26 th	545,017,973	49,019,516	21,800,719	27,218,797	517,799,176	
27 th	517,799,176	49,019,516	20,711,967	28,307,549	489,491,626	
28 th	489,491,626	49,019,516	19,579,665	29,439,851	460,051,775	84,939,947
29 th	460,051,775	49,019,516	18,402,071	30,617,445	429,434,330	
30 th	429,434,330	49,019,516	17,177,373	31,842,143	397,592,187	
31 th	397,592,187	49,019,516	15,903,687	33,115,829	364,476,358	
32 th	364,476,358	49,019,516	14,579,054	34,440,462	330,035,896	66,062,186
33 th	330,035,896	49,019,516	13,201,436	35,818,080	294,217,816	
34 th	294,217,816	49,019,516	11,768,713	37,250,804	256,967,013	
35 th	256,967,013	49,019,516	10,278,681	38,740,836	218,226,177	
36 th	218,226,177	49,019,516	8,729,047	40,290,469	177,935,708	43,977,876
37 th	177,935,708	49,019,516	7,117,428	41,902,088	136,033,620	
38 th	136,033,620	49,019,516	5,441,345	43,578,171	92,455,448	
39 th	92,455,448	49,019,516	3,698,218	45,321,298	47,134,150	
40 th	47,134,150	49,019,516	1,885,366	47,134,150	0	18,142,357

		1,960,780,648	990,548,448	970,232,200		990,548,448
Return on Commercial loan per year(sum of Yearly interest/10) =99,054,845						

5.4.6 Equity Calculation:

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

Since total rate base is = use and useful asset + total RWC (taka) = 3,465,115,000 + 3,449,260,9
= 3,499,607,609 Tk

Therefore, Equity amount = 3,499,607,609 × 0.30 = 1,049,882,283tk

Principal	=	1,049,882,283
Return on equity rate , r	=	15%
Effective plant life, n	=	15 years

We Know,

$$\begin{aligned} \text{Principal} &= A \times \text{PVIFA} \\ \Rightarrow 1,049,882,283 &= A \times \left[\frac{1 - \frac{1}{(1+r)^n}}{r} \right] \\ \Rightarrow 1,049,882,283 &= A \times \left[\frac{1 - \frac{1}{(1+0.15)^{15}}}{0.15} \right] \\ \Rightarrow 1,049,882,283 &= A \times \frac{0.877105514}{0.15} \end{aligned}$$

$$A = 179,547,773\text{tk}$$

[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	1,049,882,283	179,547,773	157,482,343	22,065,430	1,027,816,853
2 nd	1,027,816,853	1,795,477,73	154,172,528	25,375,245	1,002,441,608
3 rd	1,002,441,608	1,795,477,73	150,366,241	29,181,532	973,260,076
4 th	973,260,076	1,795,477,73	145,989,011	33,558,762	939,701,314
5 th	939,701,314	1,795,477,73	140,955,197	38,592,576	901,108,738
6 th	901,108,738	1,795,477,73	135,166,311	44,381,462	856,727,276
7 th	856,727,276	1,795,477,73	128,509,091	51,038,682	805,688,594
8 th	805,688,594	1,795,477,73	120,853,289	58,694,484	746,994,110
9 th	746,994,110	1,795,477,73	112,049,117	67,498,656	679,495,454
10 th	679,495,454	1,795,477,73	101,924,318	77,623,455	601,871,999
11 th	601,871,999	1,795,477,73	90,280,800	89,266,973	512,605,026
12 th	512,605,026	1,795,477,73	76,890,754	102,657,019	409,948,007
13 th	409,948,007	1,795,477,73	61,492,201	118,055,572	291,892,435
14 th	291,892,435	1,795,477,73	43,783,865	135,763,908	156,128,527
15 th	156,128,527	1,795,477,73	23,419,279	156,128,494	0
Sum of Yearly Interest =1,643,334,345					
Return on Equity per year(Sum of Yearly Interest/15)=109,555,623 tk					

5.4.7 Details cost of service :**Table No- 5.11****Details Cost of Service**

Net Energy Generation/kWh	41,711,760
Generation Asset In Service	3465115000

Yearly Depreciation (Taka)	216979726
Accumulated Depreciation	0
Used & Useful Asset (Taka)	3715606910

Yearly Depreciation	
Intangible Plant(Taka)	6,191,005
Production Plant(Taka)	181,973,979
General Plant(Taka)	28,814,741
Total(Taka)	216,979,726

Fuel Required (Lit/KWh)	0.218
Fuel Required (Lit)	9,093,163
Fuel Cost (Taka/Lit)	60.96
Fuel Cost (Taka)	554,349,290
Fuel Cost (Taka/KWh)	13.19

Operation & Maintenance Expenses	
Operating and Maintenance Cost (TK/KWh)	2.562
Operating and Maintenance Cost (Taka)	106,882,020
VOMP (TK/KWh)	0.1061
VOMP (Taka)	4,425,617

Total (Taka)	111,307,637
Total (Taka/KWh)	2.668

Regulatory Working Capital	
Cash Working Capital (Taka)	18,551,272
Materials & Supplies Inventory (Taka/Month)	902,340
Prepayment (Taka/Month)	15,038,997
Total-RWC (Taka)	34,492,609

Rate Base(Used & Useful Asset + Total-RWC)(Taka)	3,499,607,609
---	----------------------

Debt Amount (70%)	
ECA Loan (Taka) (60% of Debt.)	1,455,348,300
Commercial Loan (Taka)(40% of Debt.)	970,232,200
Working Capital (Taka)(70% of total RWC)	24,144,826
Total Debt Amount(Taka)	2,449,725,326

Equity Amount (30% of Rate Base)	1,049,882,283
---	----------------------

Return on Debt (Interest)	
ECA Loan (Taka)	67,270,552

Commercial Loan (Taka)	99,054,845
Working Capital (Taka)(16% of WC)	3,863,172
Total (Taka)	170,188,569

Return on Equity (Taka)	109,555,623
-------------------------	--------------------

Return on Rate Base(total Return on debt.+Return on equity)	279,744,192
--	--------------------

[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 for 50MW Oil based Power Plant :

Table No- 5.12

Costing for 50MW Oil 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)	554.34	13.19
B	Generation Service Tariff Rate (STR)		

1	Rate Base (RB)		
	Current Asset	3465.12	
	Accumulated Depreciation	0.00	
	Regulatory Working Capital	34.49	
	Total Rate Base	3499.61	
2	Return on Rate Base:		
	Interest on Debt	170.18	4.07
	Return on Equity	109.55	2.70
	Total Return on Rate Base	279.73	
3	Operating Expenses:		
	Operation & Maintenance	106.88	2.60
	Variable Operation & Maintenance Price (VOMP)/Lube Oil Cost	4.42	0.17
	Depreciation Expenses	216.98	5.20
	Total Operating Expenses	328.28	
4	Annual Revenue Requirement for STR(return on Rate Base+ Total Operating Expenses)	608.01	
5	Yearly Net Energy Generation (kWh)	41.71	
6	Service Tariff Rate (STR)/Non-Fuel Cost		14.74
7	Overall Cost		27.93

Table No-5.13

Indicative Price:			
A	Fuel Cost Recovery Tariff Rate (FCRR)	554.34	13.19
B	Generation Service Tariff Rate (STR)		
B-1	Fixed/Non Escapable Service Tariff Rate		
	Interest on Debt	170.18	4.07
	Return on Equity	109.55	2.70
	Depreciation Expenses	216.98	5.20
	Total Fixed Cost/Non Escapable Service Tariff Rate	496.71	11.97
B-2	Variable/Escapable Service Tariff Rate		
	Fixed Operation & Maintenance	106.88	2.60
	Variable Operation & Maintenance Price (VOMP)/Lube Oil Cost	4.42	0.17
	Total Escapable Service Tariff Rate	111.3	2.77

C	Total Service Tariff Rate (STR)/Non-Fuel Cost	608.01	14.74
D	Total Indicative Cost		27.93

Note : In case of Variable/Escapable 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	
	a. Flat Rate	6.95
3	b. Off-Peak Time	5.96
	c. Peak Time	8.47
4	Category-D : Non-Residential (Light & Power)	4.53
5	Category-E : Commercial And Office	

	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) about 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 disel oil as a fuel then we can reduce fuel cost of generation. Although oil is insufficient in our country. So, we should make public awareness about misuse of our oil . 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 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 high and vice-versa. In these paper, we discussed about generating cost, how to calculate generating cost with example . We also discussed about the important terms that which 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 able to calculate the tariff rate.

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