LIFE CYCLE COST ASSESSMENT FOR "SUMMIT 35 MW" GAS-BASED POWER PLANT

A Project and Thesis submitted in partial fulfillment of the requirements for the Award of Degree of Bachelor of Science in Electrical and Electronic Engineering

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Dedicated to **Our Parents**

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ABSTRACT

This thesis is on **"Life Cycle Cost Assessment" (Gas-based power plant).**

We have selected a power plant named Summit 35 MW Gas-Based power plant. To calculate or estimate unit generation cost. Financial and technical data has been collected from the EnergyPaC or primary technoeconomic data have been used for life cycle cost assessment. Tariff for consumer also estimated based on electricity bill or

Results show that the per unit electricity generation for this power plant is 4.55 BDT. Estimated consumer tariff is ***.

We compared the economical issue with Katakhali 50MW (Oil-based power plant). For gas and oil based we determined fuel cost. Then we determined the service cost. For service cost estimation we determined Operation and maintenance cost, Yearly Depreciation (for depreciation calculation we calculated Intangible plant, Production Plant & General Plant) Regulatory Working Capital, ECA Loan Calculation, Commercial Loan Calculation, Return on Equity Calculation. These are the non-fuel cost. Then we summation the fuel cost and non-fuel cost. Then we get the complete generating cost/Indicative cost for gas-based power plant and for oil-based power plant. Finally we compared them. We found that Gas-based power plant is cheaper than Oil-based power plant which is important.

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 increasein 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 theirlifetime; 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 energyinfrastructure is quite small, insufficient and poorly managed. The per capitaenergy 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'selectric power sector include corruption in administration, high system losses, delays in completion of new plants, lowefficiencies, erratic power supply, electricity theft, blackouts,Bangladesh's energyinfrastructure is quite small, insufficient and poorly managed. The per capitaenergy 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'selectric power sector include corruption in administration, high system losses, delays in completion of new plants, lowefficiencies, 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.

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 MWelectricity 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.

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 oftotal 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 ofthe 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 tobe addressed with due importance at the moment

- Inadequacy of supply ofelectricity compared to demand
- Dependency on single energy (gas) for electricity generation
- Investment or participation of private sector in electricity generation is at theminimum
- 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 anddistribution 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 thefollowing 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 (2021-2041):

- Electricity Generation in the country by 2025 – 25,000 MW

- Electricity Generation in the country by 2030 – 30,000 MW
- Electricity Generation in the country by 2041 - 40,000 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
- To address the issues the following constraints, possibilities and strategies are identified:

Constraints

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

Possibilities

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

Strategies:

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

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. To do this;

1. To find unit generation cost of a power plant.
2. To estimate Operation & Maintenance cost of a power plant.
3. To find fuel cost of a power plant.
4. To compare the results with other power plants.

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.

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).

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 thepoles 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.

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 costelectricity generated in the Eastern Zone is transferred to the Western Zone through the 230kV East-West Inter connector transmission line.

2.5 Important terms for Calculation:

Availability Factor: means he 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 inevery 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 hadoperated 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 Powe r Producer/Small Powe r 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.

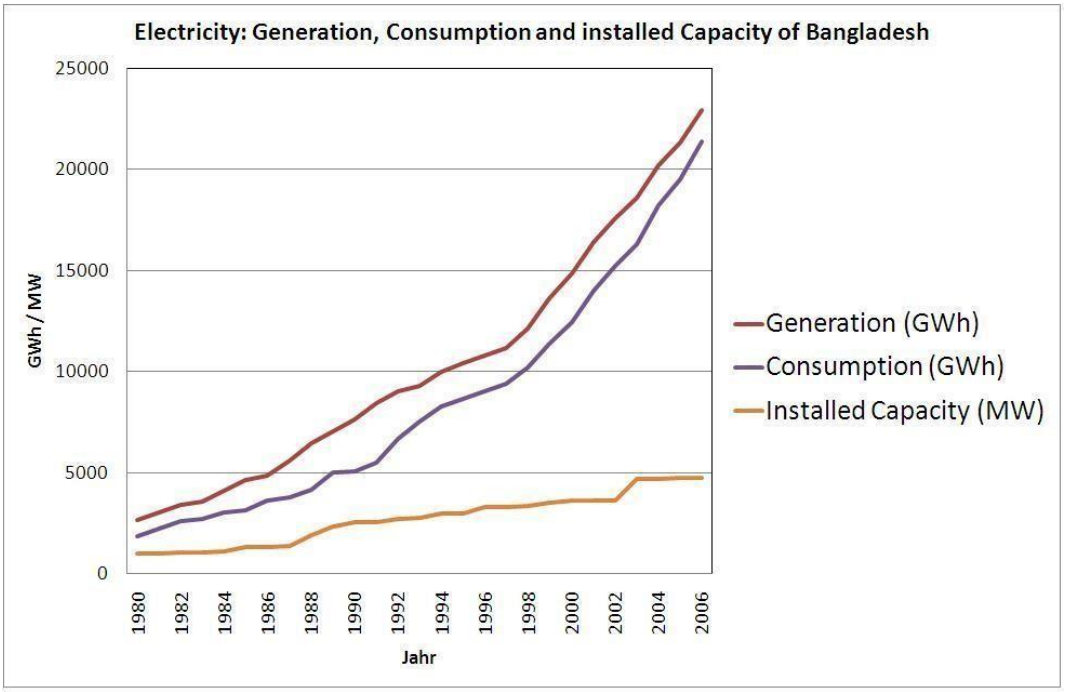
Terms and Conditions of Service : means a published document included as part of a licensee‟s tariff that establishes the licensee‟s terms and conditions for providing service to a customer, discussing such issues as the conditions under which connection will be provided to a customer, metering, disconnection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

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%

Table No-2.2



Chapter 3

Fuel cost calculation method

3.1 Fuel charge :

In elcctricity generation, fuel charge is the amount of cost that calculate for per unitgeneration. 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 themonth‟s consumption. The customer‟s total charge will be the sum of these two amounts.

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 forthe 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 purposesof 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 includedfor 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%

Plant factor = $\frac{648{,}000}{1{,}000\times30\times24}$ = 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 lowerthe plant‟s heat rate, the higher the plant‟s efficiency, because it requires fewer units of fuelinput toproduce a kwh ofelectricity.

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 43.0MJ/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 tocalculate 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 .

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 ofits 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

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 profitor 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

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 BERC)

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 normaloperating 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

4.3.1 Cash working capital :

Cash working capital represents the licensee provided cash required for payment of operation expenses, to maintain compensating cash ba lances, 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 generatio n.
Cash Working Capital = 1/6 x (Annual Operation & Maintenance Expenses)

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

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

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

Exmple

Regulatory Working Capital for Generation

Cash working capital

(One-sixth of operation and maintenance expense, excluding fuel) 2,586,360,000 Taka

Fosssil 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 comple ted 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)

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 =

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

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 provideadequate support to justify that Tariff Rate.

4.5.1 Return on Debt :

D%=

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

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 costcalculation 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 futuredate 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:

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

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.

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:

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

As an example for a government owned generation licensee, the following sa mple 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 thislicensee‟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.

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 toproducing 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.

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

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 othertax 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.

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 multipliedtimes the proposed revenue increase to develop a recommended revenue increase.

Recommended Revenue Increase = Proposed Revenue Increase * Revenue Conversion Factor

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).

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 themonth‟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 genertion
    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-1:

For tariff calculation of a Summit 35MW gas-based 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	35	MW
2	Monthly Operation Hour	705	Hours
3	Plant Factor	65	%
4	Yearly Net Generation	**578160**	kWh
5	Net Heat Rate	5582	KJ/kWh
6	Fuel (Gas) Price	10	Taka/MCF
7	Fixed Operation & Maintenance Cost (Tk/KW/Month)	110	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)**	65%	%
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)	65%	%
14	Return on Equity	20%	%
15	**Rate of Interest of Debt:**		
16	Rate of Interest of Foreign/ECA Loan Facilities	0.60%	%
17	Rate of Interest of Local/Commercial Loan Facilities	16.00%	%
18	Rate of Interest of Working Capital Loan Facilities	2.6%	%
19	Average Rate of Interest	2.6%	%
20	Effective Plant Life	10	Years
21	Loan Repayment (1 Year Grace Period and Quarterly Installment)	5	Years
22	Corporate Income Tax	Nill	
23	Salvage Value	5%	%

Table No-5.2

PROJECT COST FOR Summit 35 MW GAS-BASED POWER PLANT

SL. No.	Items	BDT	$/kW	Share of Investment (%)
1.0	**Intangible Plant: (1)**	**14998751**		**1.24%**
2.0	**Production Plant/Plant Machinery and Equipment:**			
2.1	Plant and Machinery C&F, 11/33 KV Sub-Station, Power Evacuation Line, RMS	464065823		38.37%
	Sub-Total:(2)			
3.0	**General Plant:**			
3.1	Land and Land Development	117655772		9.72%
3.2	Infrastructure (Building & Civil Works)	112893285		9.33%
3.3	Office Furniture and Equipments	35594488		2.94%
3.4	Laboratory Equipments	56446642		4.66%
3.5	Electric Equipments	56446642		4.66%
3.6	Transportation & Communication Equipments	56446642		4.66%
3.7	Miscellaneous Equipments	16837480		1.39%
3.8	Other Tangible Equipments	56446642		4.66%
3.9	Interest During Construction	107851705		8.91%
3.10	Contingencies	121625536		10.05%
	Sub-Total:(3)	**730146977**		**60.38%**
	Total Project Cost: [1+2+3]	**1209211551**		**100%**

Table No- 5.3

Assumption	BDT
Total of 12 Months Value Materials and Supplies	8121060
One Average Year of Pre-paid Items	135350973

5.3 Fuel cost calculation :

Net Generation per year = capacity ×hours per year × plant factor

= 35 × 1000 × 705 × 12 × 0.65

= 192465000 kWh

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

Given that heat rate = 5582 kj/kwh

Total heat required for generation = **192465000**×5582

= 1.07433963×10^12kj

Now,

Fuel required for generation = 3.168*192465000

= 609873468 cft

Total cost = 194944829 tk

Fuel cost per year = 194944829/609873468

= 0.31 tk

Now, fuel cost per unit = 0.98 tk/kwh

Table No- 5.4

Fuel Required (Cft/kWh)	3.168
Fuel Required (Cft)	**609873468**
Fuel Cost (Taka/Cft)	**0.31**
Fuel Cost (Taka)	194944829
Fuel Cost (Taka/kWh)	0.98

5.4 Service Charge Calculation:

Assumed that, for 65% plant factor the reference Escalable capacity price is 110 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:

Operation and maintenance cost = capacity × capacity price per month

= 35 × 1000 × 110 × 12

= 46200000 Tk

Operation and maintenance cost per unit kwh = 46200000/192465000

=0.24004 Tk/kWh

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

Now VOMP cost /KWh = $\frac{315 \times .30}{890}$ = **0.1061 Tk/KWh**

Variable operation and maintenance

Payment for net generation = 0.1061 × 192465700

= **20420536.5 Tk**

- **Total operation & maintenance Expenses = 66620536.5 Tk**
- **Total operation & maintenance Expenses per kWh = 0.34614 tk/kWh**

Table No- 5.5

Operation & Maintenance Expenses	
Operating and Maintenance Cost (TK/kWh)	0.24004
Operating and Maintenance Cost (Taka)	46200000
VOMP (TK/kWh)	0.1061
VOMP (Taka)	20420536.5
Total (Taka)	**66620536.5**
Total (Taka/kWh)	**0.34614**

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 = 14998751 Tk

Salvage value, s = 5.00%

Service life, n = 10 years

Using Straight line method,

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

= (14998751-5)/10

= 1499874.6 Tk

Annual Depreciation rate for intangible plant = 1499874.6 Tk

2. **Production plant:-**

Investment, p = 464065823 Tk

Salvage value, s = 5% of investment

= 0.05× 464065823

= 23203291.15 Tk

Service life, n = 10

Now,

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

=(464065823-23203291)/10

= 44086253.19 Tk

Annual Depreciation rate for production plant = 44086253.19 Tk

3. General plant:-

- **Land and land development rate** :- Investment = 1173655772 Tk

Salvage value, s = 5.00%

Service life, n = 10 years

Annual Depreciation rate =(1173655772-5)/10

Annual Depreciation rate=117365576 tk

In these case, Assumed that Depreciation rate = 0.00%

- **Infrastructure:-** Investment = 112893285 Tk

Salvage value = 5% of investment

= 0.05 × 112893285 =5644664.25 Tk

Service life, n = 10 years

Annual Depreciation rate=(112893285-5644664.25)/10

= 10724862.08 Tk

- **Office furniture and equipment:-**

Investment, p = 35594488 Tk

Salvage value, s = 5% of investment

= 0.05 × 35594488Tk

= 1779724.4 Tk

Service life, n = 10 years

Annual Depreciation rate =(35594488-1779724.4)/10

= 3381476.36 tk

- **Laboratory Equipments:-** Investment, p = 56446642 Tk

Salvage value, s = 5% of investment

= 0.05 × 56446642

= 2822332.1 tk

Service life,n = 10 years

Annual Depreciation rate=(56446642-2822332.1)/10

= 5362431 Tk

Electric equipments:- Investment, p =56446642 Tk

Salvage value, s = 5% of investment

= 0.05× 56446642

= 2822332.1 Tk

Service life, n = 10 years

Annual Depreciation rate=(56446642-2822332.1)/10

= 5362431 tk

- **Communication Equipments:-** Investment, p = 56446642 Tk

Salvage value,s = 5% of investment

= 0.05 × 56446642

=2822332.1 tk

Service life, n = 10 years

Annual Depreciation rate=(56446642-2822332.1)/10

=5362431 Tk

- **Miscellenious Equipments:-** Investment,p = 16837480 Tk

Salvage value,s = 5% of investment

= 0.05 × 16837480

= 841874Tk

Service life, n = 10 years

Annual Depreciation rate= (16837480-841874)/10

= 1599560.6 Tk

- **Other tangible Equipments:-** Investment,p = 56446642 Tk

Salvage value,s = 5% of investment

=0.05 × 56446642

=5362431 Tk

Service life, n = 10 years

Annual Depreciation rate=(56446642-2822332.1)/10
=5362431 Tk

- **Interest during construction:-** Investment,p = 107851705 Tk

Salvage value,s = 5% of investment
= 0.05 × 107851705
=5392585.25 Tk
Service life, n = 10 years

Annual Depreciation rate=(10781705-5392585.25)/10

= 9945911.97 Tk

- **Contingencies :-** Investment, p = 121625536 Tk

Salvage value ,s = 5% of investment
=0.05 × 121625536
=6081276.8 Tk
Service life ,n = 10 years

Annual Depreciation rate=(121625536-6081276.8)/10

= 115544259.2 TK

Total Annual depreciation of general plant = **280013170.21** Tk

Now Total Yearly Depreciation = (1499874.6 + 4408625.19 +280013170.21)

= **325599298 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	**Intangible Plant**	14998751	5.00 %			10	1499874.6
2	**Production Plant**	464065823	5.00 %	23203291	440862532	10	**44086253.19**
3	**General Plant**						
4	Land and Land Development	1173655772	0.00 %	0.00	1173655772	10	117365576
5	Infrastructure	112893285	5.00 %	5644664.25	107248621	10	10724862.08
6	Office Furniture and equipments	35594488	5.00 %	1779724.4	33814763	10	3381476.36
7	Laboratory Equipments	56446642	5.00 %	2822332.1	53624310	10	5362431
8	Electric Equipments	56446642	5.00 %	2822332.1	53624310	10	5362431
9	Communication Equipments	56446642	5.00 %	2822332.1	53624310	10	5362431
10	Miscellaneous Equipments	16837480	5.00 %	841874	159956.60	10	1599560.6
11	Other Tangible Equipments	56446642	5.00 %	2822332.1	53624310	10	5362431
12	Interest During Construction	10781705	5.00 %	5392585.25	994591.91	10	9945911.97
13	Contingencies	121625536	5.00 %	6081276.8	11554425.29	10	115544259.2
	Sub Total of General Plant	**1794244834**		**20869057.1**	**368269597.8**		**280011370.2**
	Total	**2273309408**		**44072348.1**	**824130880.8**		**325597498.005**

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×(66620536.5)

=11103422.75 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

=8121060/12

=676755 Tk/month

=19335.85 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

= 135350973/12

=**11279247.75 tk/month**

=322264.22 Tk/MW

It is the monthly cost per MW

Table No- 5.7

Regulatory Working Capital	
Cash Working Capital (Taka)	11103422.75
Materials and supplies inventory (Taka/month)	676755
Prepayment (Taka/month)	11279247.75
Total-RWC (Taka)	**23059425.5**

5.4.4 ECA Loan Calculation :

Given that , Loan/Debt amount is 65% of Used & Useful Asset = **1209211551**×0.65

= 785987508.15 Tk

And ECA loan is 60% of debt amount that is ECA loan = 785987508.15×0.60

= 471592504.89 Tk

Principal p =	471592504
Yearly interest rate, r =	0.60%
Quarterly interest rate,(r/4) =	2%
Number of installments, n =	40

We Know,

Principal = A×PVIFA

$$\Rightarrow 471592504.89 = A\times\left[=\frac{\{1-\frac{1}{(1+r)^n}\}}{r}\right]$$

$$\Rightarrow 471592504.89 = A\times\left[\frac{\{1-\frac{1}{(1+0.02)^{40}}\}}{0.02}\right]$$

$$\Rightarrow 471592504.89 = A\times \frac{0.5471}{0.02}$$

A = 17239718.67 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
1st	471592504.89	**17239718.67**	9431850.09	7807868.57	463784635.42	
2nd	463784635.42	**17239718.67**	9275692.70	7964025.29	455820610.12	
3rd	455820610.12	**17239718.67**	9116412.20	8123306.46	447697303.65	
4th	447697303.65	**17239718.67**	8953946.07	8285771.92	439411531.0	**36777901.06**

					7	
5th	439411531.07	**17239718.67**	8788230.62	8451488.04	430960043.02	

6th	430960043.02	**17239718.67**	861920.08	16377798.59	414582244.43	
7th	414582244.43	**17239718.67**	8291644.89	8948073.78	405634170.64	
8th	405634170.64	**17239718.67**	8112683.41	9127035.25	396507135.39	26054473
9th	396507135.39	**17239718.67**	7930142.70	9309575.97	387197559.42	
10th	387197559.42	**17239718.67**	7743951.18	9495767.48	377701791.93	
11th	377701791.93	**17239718.67**	7554035.83	9685682.83	368016109.09	
12th	368016109.09	**17239718.67**	7360322.18	9879396.48	358136712.60	30588451.89
13th	358136712.60	**17239718.67**	7162734,25	10076984.41	348059728.18	
14th	348059728.18	**17239718.67**	6961194.56	10278524.10	337781203.89	
15th	337781203.89	**17239718.67**	6755624.07	10484094.59	327297109.29	
16th	327297109.29	**17239718.67**	6545942.18	10693776.48	316603332.80	27425495.06
17th	316603332.80	**17239718.67**	6332066.65	10907652.01	305695680.78	
18th	305695680.78	**17239718.67**	6113913.61	11125805.05	294569875.72	
19th	294569875.72	**17239718.67**	5891397.51	11348321.15	283221554.56	
20th	283221554.56	**17239718.67**	5664431.09	11575287.57	271646266.98	24001808.86
21th	271646266.98	**17239718.67**	5432925.33	11806793.33	25989473.64	

22th	259839473.64	**17239718.67**	5196789.47	12042929.19	247796544.44	
23th	247796544.44	**17239718.67**	4955930.89	12283787.78	235512756.65	
24th	235512756.65	**17239718.67**	4710255.13	12529463.53	222983293.11	20295900.82
25th	222983293.11	**17239718.67**	4459665.86	12780052.81	210203240.3	
26th	210203240.3	**17239718.67**	4204064.80	13035653.86	197167586.43	
27th	197167586.43	**17239718.67**	3943351.72	13296366.94	183871220.01	

28th	183871220.01	**17239718.67**	3677424.40	13562294.27	170308925.74	16284506.78
29th	170308925.74	**17239718.67**	3406178.51	13833540.15	156475385.58	
30th	156475385.58	**17239718.67**	3129507.71	14110210.96	142365174.62	
31th	142365174.62	**17239718.67**	2847303.49	14392415.18	127972759.44	
32th	12792759.44	**17239718.67**	2559455.19	14680263.48	113292495.96	11942444.9
33th	113292495.96	**17239718.67**	2265849.92	14973868.75	98318627.21	
34th	98318627.21	**17239718.67**	1966372.54	15273346.12	83045281.08	
35th	83045281.08	**17239718.67**	1660905.62	15578813.05	67466468.03	
36th	67466468.03	**17239718.67**	1349329.36	15890389.31	51576078.72	7242457.44
37th	51576078.72	**17239718.67**	1031521.57	16208197.09	35367881.62	
38th	35367881.62	**17239718.67**	707357.63	16532361.03	18835520.58	
39th	18835520.58	**17239718.67**	376710.41	16863008.26	1972512.32	
40th	1972512.32	**17239718.67**	39450.24	17200268.42	0	2155039.85
		689588746.8		202768485.66		**202768485.66**

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

5.4.5 Commercial loan Calculation:

Given that , Loan/Debt is 65% of Used & Useful Asset = **1209211551**×0.65

= 785987508.15 Tk

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

Now the Commercial loan is = 785987508.15×0.40 = 314395003.26 Tk.

Principal =	314395003.26
Yearly interest rate, r =	2.6%
Quarterly interest rate, (r/4)=	0.65%
Number of installments, n =	40

We Know,

Principal = A×PVIFA

=> 314395003.26= A×[= $\frac{\{1-\frac{1}{(1+r)^n}\}}{r}$]

=> 314395003.26= A×[{1-1/(1+0.0065)^{40}}/0.0065]

=> 314395003.26=A× 0.224806/0,0065

A = 9090360.23 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)×(0.0065)	Principal Repayment (4)=(2)-(3)	Principal Ending (5)=(1)-(4)	Yearly Interest
1st	314395003.26	9090360.23	2043567.52	7046792.71	307348210.55	
2nd	307348210.55	9090360.23	1997763.37	7092596.86	303255613.69	
3rd	303255613.69	9090360.23	1951661.49	7138698.74	296116914.95	
4th	296116914.95	9090360.23	1924759.95	7165600.28	288951314.67	791752.33
5th	288951314.67	9090360.23	1878183.54	7212176.68	281739137.98	
6th	281739137.98	9090360.23	1831304.31	7259055.83	274480082.15	
7th	274480082.15	9090360.23	1784120.53	7306239.61	267173842.45	
8th	267173842.45	9090360.23	1736629.97	7353730.25	259820112.19	7230238.35
9th	259820112.19	9090360.23	1688830.73	7401529.50	252418582.69	

10th	252418582.69	9090360.23	1640720.79	7449639.44	244968943.25	
11th	244968943.25	9090360.23	1592298.13	7498062.09	237470881.15	
12th	237470881.15	9090360.23	1543560.73	7546799.50	229924081.65	6465410.38
13th	229924081.65	9090360.23	1494506.53	7595853.69	222328227.95	

14th	222328227.95	9090360.23	1445133.48	7645226.75	214683001.20	
15th	214683001.20	9090360.23	1395439.51	7694920.72	206988080.48	
16th	206988080.4	9090360.23	1345422.52	7744937.70	199243142.77	5680502.04
17th	199243142.77	9090360.23	1295080.42	7795279.80	191447862.97	
18th	191447862.97	9090360.23	1244411.11	7845949.12	183601913.85	
19th	183601913.85	9090360.23	1193412.44	7896947.79	175704966.06	
20th	175704966.06	9090360.23	1142082.28	7948277.95	167756688.11	3754988.25
21th	167756688.11	9090360.23	1090418.47	7999941.76	159756746.35	
22th	159756746.35	9090360.23	1038418.85	8051941.38	151704804.97	
23th	151704804.97	9090360.23	986081.23	8104278.99	143600525.97	
24th	143600525.97	9090360.23	933403.42	8156956.81	135443569.16	4048321.97
25th	135443569.16	9090360.23	880383.19	8209977.03	127233592.13	
26th	127233592.13	9090360.23	827018.35	8263341.88	118970250.25	
27th	118970250.25	9090360.23	773306.63	8317053.60	110653196.65	
28th	110653196.65	9090360.23	719245.78	8371114.45	102282082.2	3199953.95
29th	102282082.2	9090360.23	664833.53	8425526.69	93856555.50	
30th	93856555.50	9090360.23	610067.61	8480292.39	85376263.11	
31th	85376263.11	9090360.23	554945.71	8535414.51	76840848.48	
32th	76840848.48	9090360.23	499465.51	8590894.48	68249953.99	2329312.36
33th	68249953.99	9090360.23	443624.7	8646735.53	59603218.46	
34th	59603218.46	9090360.23	387420.92	8702939.31	50900279.15	
35th	50900279.15	9090360.23	330851.81	8759508.41	42140770.73	
36th	42140770.73	9090360.23	273915	8816445.22	33324325.5	1435812.43
37th	33324325.5	9090360.23	216608.11	8873752.11	24450573.38	
38th	24450573.38	9090360.23	158928.73	8931431.5	15519141.87	
39th	15519141.87	9090360.23	100874.42	8989485.81	6529656.07	
40th	6529656.07	9090360.23	42442.76	9047917.46	0	518854.02
		363614409.2				**35455146.08**
Return on Commercial loan per year(sum of Yearly interest/10) =35455146.08 Tk						

5.4.6 Equity Calculation:

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

Since total rate base is = 2627565650

Therefore, Equity amount = 2627565650 ×0.30 = 788269695.07 tk

Principal	=	788269695.07
Return on equity rate ,	r =	20%
Effective plant life,	n =	10 years

We Know,

Principal = A × PVIFA

=> 788269695.07= $A \times \left[\frac{\{1-\frac{1}{(1+r)^n}\}}{r}\right]$

=>788269695.07= $A \times [\{1-1/(1+0.2)^{10}\}/0.2]$

=> 788269695.07= A×0.8384491/0.2

A =188030423.09 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)
1st	788269695.07	188030423.09	157653939.01	186453884.08	61815810.99
2nd	61815810.99	188030423.09	120363162.1	67667260.89	534148550.1
3rd	534148550.1	188030423.09	106829710.02	81200713.07	452947837.03
4th	452947837.03	188030423.09	90589567.40	97440855.69	355506981.34
5th	355506981.34	188030423.09	71101396.27	140314832.19	238577954.52
6th	238577954.52	188030423.09	47715590.90	14031432.19	238577954.52
7th	238577954.52	188030423.09	19652624.47	168377798.62	0
Sum of Yearly Interest			**=570961959.17 Tk**		
Return on Equity per year(Sum of Yearly Interest/10)= 570961959.17 tk					

5.7 Details cost of service :

Table No- 5.11

Details Cost of Service	
Net Energy Generation/kWh	578160
Generation Asset In Service	1209211551
Yearly Depreciation (Taka)	**325597498**
Accumulated Depreciation	0
Used & Useful Asset (Taka)	1209211551

Yearly Depreciation	
Intangible Plant(Taka)	1499874.6
Production Plant(Taka)	44086253.19
General Plant(Taka)	280011370.21
Total(Taka)	325597498

Fuel Required (Cft/kWh)	3.168
Fuel Required (Cft)	609873468
Fuel Cost (Taka/Cft)	0.31
Fuel Cost (Taka)	194944829
Fuel Cost (Taka/kWh)	0.98

Operation & Maintenance Expenses	
Operating and Maintenance Cost (TK/kWh)	0.24004
Operating and Maintenance Cost (Taka)	46200000
VOMP (TK/kWh)	0.1061
VOMP (Taka)	2042536.5
Total (Taka)	**66620536.5**
Total (Taka/kWh)	**0.34614**

Regulatory Working Capital	
Cash Working Capital (Taka)	11103422.75
Materials & Supplies Inventory (Taka/Month)	676755
Prepayment (Taka/Month)	11279247.75
Total-RWC (Taka)	**23059425.5**

Rate Base(Used & Useful Asset + Total-RWC)(Taka)	**1232270976.5**

Debt Amount (65%)	

ECA Loan (Taka)	(60% of Debt.)	471592504.89
Commercial Loan (Taka)	(40% of Debt.)	314395003.26
Working Capital (Taka)	(65% of total RWC)	14988626.25
Total Debt Amount(Taka)		**376543134.4**

Return on Debt (Interest)	
ECA Loan (Taka)	**202768485.66**
Commercial Loan (Taka)	**35455146.08**
Working Capital (Taka) (16% of WC)	239180.2
Total (Taka)	**240621811.94**

Return on Equity (Taka)	**57096195.92**

Return on Rate Base(total Return on debt.+Return on equity)	**297718007.86**

[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 Summit 35MW power plant :

Table No- 5.12

Costing for 35MW 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)**	**194.944**	**0.98**
B	**Generation Service Tariff Rate (STR)**		
1	**Rate Base (RB)**		
	Current Asset	1209.21	
	Accumulated Depreciation	0.00	
	Regulatory Working Capital	23.05	
	Total Rate Base	**1232.2**	
2	**Return on Rate Base:**		
	Interest on Debt	240.62	1.25
	Return on Equity	57.09	0.29
	Total Return on Rate Base	**297.72**	
3	**Operating Expenses:**		
	Operation & Maintenance	46.2	0.24
	Variable Operation & Maintenance Price (VOMP)/Lube Oil Cost	20.42	0.10
	Depreciation Expenses	325.59	1.69
	Total Operating Expenses	**392.21**	
4	**Annual Revenue Requirement for STR(return on Rate base+ Total Operating Expenses)**	**689.93**	
5	**Yearly Net Energy Generation (kWh)**	**0.57**	
6	**Service Tariff Rate (STR)/Non-Fuel Cost**		**3.57**
7	**Overall Cost**		**4.55**

Table No-5.13

Indicative Price:			
A	**Fuel Cost Recovery Tariff Rate (FCRR)**	**194.944**	**0.98**
B	**Generation Service Tariff Rate (STR)**		

B-1	**Fixed/Non Escalable Service Tariff Rate**		
	Interest on Debt	240.62	1.25
	Return on Equity	57.09	0.29
	Depreciation Expenses	325.59	1.69
	Total Fixed Cost/Non Escalable Service Tariff Rate	**623.3**	**3.23**
B-2	**Variable/Escalable Service Tariff Rate**		
	Fixed Operation & Maintenance	46.2	0.24
	Variable Operation & Maintenance Price (VOMP)/Lube Oil Cost	20.42	0.10
	Total Escalable Service Tariff Rate	**66.62**	**0.34**
C	**Total Service Tariff Rate (STR)/Non-Fuel Cost**	**689.92**	**3.57**
D	**Total Indicative Cost**		**4.55**

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 Assumption data-2: For tariff calculation of Katakhali 50MW Oil-based power plant, assumption data is given in below:

Table No: 5.14

SL NO	Parameter/Assumption/Boundary Condition		Unit
1	Net Capacity of the Power Plant	50	MW
2	Monthly Operation Hour	628	Hours
3	Plant Factor	11.07%	%
4	Yearly Net Generation	**41711760**	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%	%
16	**Rate of Interest of Debt:**		
16.1	Rate of Interest of Foreign/ECA Loan Facilities	8%	%
16.2	Rate of Interest of Local/Commercial Loan Facilities	16%	%
16.3	Rate of Interest of Working Capital Loan Facilities	16%	%
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	Nill	
20	Salvage Value	5%	%

Table No-5.15

PROJECT COST FOR 50 MW OIL BASED POWER PLANT

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%**

Table No- 5.16

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

5.8 Fuel cost calculation :

Net Generation per year = capacity×hours per year× plant factor

$= 50 \times 1000 \times 628 \times 12 \times 0.1107$

= 41,711,760 KWh

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

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

Total heat required for generation = 41,711,760×39000

$= 1.626 \times 1012$Kj

Again given heat rate for LFO = 42200 kj/litre

Heat require for generation = 41,711,760×42200

$= 1.760 \times 1012$Kj

Total heat required for generation = 1.626×1012 + 1.760×1012

$= 3.386 \times 1012$

Fuel required per unit generation = 0.218 litre

Fuel required for generation per year = 41,711,760 × 0.218

= 9,093,163 litre

Total fuel required per unit generation=9093163/41711760

= 0.217 Lit/KWh

Fuel cost per unit = 13.29 TK

Fuel cost per year = 41,711,760×13.29

= 554,349,290 Tk

Fuel cost (Tk/lit) =554349290/9093163

= 60.96 Tk/lit Now,

Fuel cost per unit = 554,349,290/41,711,760

= 13.29 Tk/KWh

Table No- 5.17

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

5.9 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

5.9.1 Operation & Maintenance Expenses:

Operation and maintenance cost = Capacity × Capacity price per month

= 50 × 1000 × 178.1367 × 12

= 106,882,020 Tk

Operation and maintenance cost per unit kwh =106,882,020/41,711,760

= 2.562 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

Now VOMP cost /KWh =(300*0.35)/890

= 0.1179 Tk/KWh

Variable operation and maintenance Payment for net generation = 0.1061 × 41,711,760

= 4,425,617Tk

- Total Operation & Maintenance Expenses = 111,307,637Tk
- Total Operation & Maintenance Expenses per KWh = 2.668Tk/KWh

Table No- 5.18

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**

5.9.2 Depreciation calculation:-

For Depreciationcalculation 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, 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,

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

= (92865082-0)/15

= 6191005 Tk

Annual Depreciation rate for intangible plant = 6191005 Tk

2.Production plant:-

Investment, p = 2873223358 Tk

Salvage value,s = 5% of investment

= 0.05× 2873223358

= 143663668 Tk

Service life,n = 15

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

= (2873223358-0)/ 143663668

= 181,973,979 Tk

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

3. General plant:-

ϖ Land and land development rate:-

Investment, p = 44,006,961 Tk

Salvage value, s = 0.00%

Service life, n = 15 years

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

= (44,006,961-0)/15

In these case, Assumed that Depreciation rate = 0.00%

ϖ Infrastructure:-

Investment = 115,041,818 Tk

Salvage value= 5% of investment

= 0.05 × 115,041,818

=5,752,091 Tk

Service life,n = 15 years

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

= (115,041,818-5,752,091)/15

= 7,285,982 Tk

ϖ Office furniture and equipment:-

Investment, p= 3,465,115 Tk

Salvage value,s= 5% of investment

= 0.05 × 3,465,155 Tk

= 173,256 Tk

Service life, n= 15 years

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

= (3,465,115-173,256)/15

= 219,457 TK

ϖ Laboratory Equipments:-

Investment, p= 1,732358 Tk

Salvage value,s= 5% of investment

= 0.05 × 1,732,358

= 86,628 Tk

Service life, n= 15 years

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

= (1,732358- 86,628)/15

= 109,729 Tk

Communication Equipments:-

Investment, p= 23,562,782 Tk

Salvage value,s= 5% of investment

= 0.05 × 23,562,782

=1,178,139 tk

Service life, n= 15 years

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

= (23,562,782-1,178,139)/15

=1,492,310 Tk

Miscellaneous Equipments:-

Investment, p= 1,732,558 Tk

Salvage value, s= 5% of investment

= 0.05 × 1,732,558

= 86,628 Tk

Service life, n= 15 years

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

= (1,732,558-86,628)/15

= 109,729 Tk

Other tangible Equipments:-

Investment, p= 1,732,558 Tk

Salvage value,s= 5% of investment

=0.05 × 1,732,558

=86,628 Tk

Service life, n= 15 years

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

= (1,732,558-86,628)/15

= 109,729 Tk

Interest during construction:-

Investment, p= 143,802,273 Tk

Salvage value, s = 5% of investment

= 0.05 × 143,802,273

=7,190,114 Tk

Service life, n= 15 years

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

= (143,802,273-7,190,114)/15

= 9,107,477 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

Annual Depreciation rate = $\frac{p-s}{n}$ = (162,167,382-8,108,369)/15

= 10,270,601 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- 5.18

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**	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**					15	
4	Land and Land Development	44,006,961	0.00 %	0.00	44,006961	15	0.00
5	Infrastructure	115,041,818	5.00 %	5,752,091	109,289,727	15	7,285,982
6	Office Furniture and equipment	3,463,115	5.00 %	173,256	3,291,859	15	219,457
7	Laboratory Equipment	1,732,558	5.00 %	86,628	1,645,930	15	109,729
8	Electric Equipment	1,732,558	5.00 %	86,628	1,645,930	15	109,729

9	Communication Equipment	23,562,782	5.00 %	1,178,139	22,384,643	15	1,492,310
10	Miscellaneous Equipment	1,732,558	5.00 %	86,628	1,645,930	15	109,729

11	Other Tangible Equipment	1,732,558	5.00 %	86,628	1,645,930	15	109,729
12	Interest During Construction	143,802,273	5.00 %	7,190,114	136,612,159	15	9,107,477
13	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	**3,465,115,00 0**		**166,412,148**	**3,298,702,852**		**216,979,726**

5.9.3 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

=14,216,287Tk/Month

=284,326Tk/MW

It is the monthly cost per MW

Table No- 5.20

Regulatory Working Capital	
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**

5.10 ECA Loan Calculation:

Given that,

Loan/Debt amount is 70% of Used & Useful Asset = 3,465,115,000×0.70

= 2,425,580,500 tk

And ECA loan is 60% of debt amount that is ECA loan = 2,425,580,500×0.60

= 1,455,348,300 TK

We know,

Principal = A×PVIFA

$$=>1{,}455{,}348{,}300 = A\times[=\frac{\{1-\frac{1}{(1+r)^n}\}}{r_1}]$$

$$=>1{,}455{,}348{,}300 = A\times\frac{\{1-\frac{1}{(1+0.02)^{40}}\}}{0.02}$$

$$=>1{,}455{,}348{,}300 = A\times(0.5471/0.02)$$

A= 53201345.41 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- 5.21

Quarters	**Principal Beginning (1)**	**Instalment (2)**	**Quarterly Interest (3)=(1)×(.02)**	**Principal Repayment (4)=(2)-(3)**	**Principal Ending (5)=(1)-(4)**	**Yearly Interest**
1st	1,455,348,300	53,201,345	29,106,966	24,094,379	1,431,253,921	
2nd	1,431,253,921	53,201,345	28,625,078	24,576,267	1,406,677,654	
3rd	1,406,677,654	53,201,345	28,133,553	25,067,792	1,381,609,861	

4th	1,381,609,861	53,201,345	27,632,197	25,569,148	1,356,040,713	113,497,795
5th	1,356,040,713	53,201,345	27,120,814	26,080,531	1,329,960,182	
6th	1,329,960,182	53,201,345	26,599,204	26,602,142	1,303,358,040	
7th	1,303,358,040	53,201,345	26,067,161	27,134,185	1,276,223,856	
8th	1,276,223,856	53,201,345	25,524,477	27,676,868	1,248,546,987	105,311,656
9th	1,248,546,987	53,201,345	24,970,940	28,230,406	1,220,316,582	
10th	1,220,316,582	53,201,345	24,406,332	28,795,014	1,191,521,568	
11th	1,191,521,568	53,201,345	23,830,431	29,370,914	1,162,150,654	
12th	1,162,150,654	53,201,345	23,243,013	29,958,332	1,132,192,321	96,450,716
13th	1,132,192,321	53,201,345	22,643,846	30,557,499	1,101,634,822	
14th	1,101,634,822	53,201,345	22,032,696	31,168,649	1,070,466,173	
15th	1,070,466,173	53,201,345	21,409,323	31,792,022	1,038,674,151	
16th	1,038,674,151	53,201,345	20,773,483	32,427,862	1,006,246,289	86,859,349
17th	1,006,246,289	53,201,345	20,124,926	33,076,420	973,169,869	
18th	973,169,869	53,201,345	19,463,397	33,737,948	939,431,921	
19th	939,431,921	53,201,345	18,788,638	34,412,707	905,019,214	
20th	905,019,214	53,201,345	18,100,384	35,100,961	869,918,253	76,477,346
21th	869,918,253	53,201,345	17,398,365	35,802,980	834,115,273	
22th	834,115,273	53,201,345	16,682,305	36,519,040	797,596,233	
23th	797,596,233	53,201,345	15,951,925	37,249,421	760,346,812	

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

5.10.1 Commercial loan Calculation:

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

Since the commercial loan is 40% of total debt amount,
Now the Commercial loan is = 2,425,580,500×0.40 = 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,

Principal = A×PVIFA

$$=> 970,232,200 = A\times\frac{\{1-\frac{1}{(1+r)^n}\}}{r}$$

$$=> 970,232,200 = A\times\frac{\{1-\frac{1}{(1+0.04)^{40}}\}}{0.04}$$

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

A=49,019,516,20 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- 5.22

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

18th	728,275,191	49,019,516	29,131,008	19,888,509	708,386,682	

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

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,

Principal = A × PVIFA

$$=> 1{,}049{,}882{,}283 = A \times \frac{\{1-\frac{1}{(1+r)^n}\}}{r}$$

=> 1,049,882,283 = A × (0.877105514/0.15)

A= 179547773 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- 5.23

Return on Equity

No. of years	Principal Beginning (1)	Installment (2)	Yearly Interest (3)	Principal Repayment (4)=(2)-(3)	Principal Ending (5)=(1)-(4)
1st	1,049,882,283	179,547,773	157,482,343	22,065,430	1,027,816,853
2nd	1,027,816,853	1,795,477,73	154,172,528	25,375,245	1,002,441,608
3rd	1,002,441,608	1,795,477,73	150,366,241	29,181,532	973,260,076
4th	973,260,076	1,795,477,73	145,989,011	33,558,762	939,701,314
5th	939,701,314	1,795,477,73	140,955,197	38,592,576	901,108,738
6th	901,108,738	1,795,477,73	135,166,311	44,381,462	856,727,276
7th	856,727,276	1,795,477,73	128,509,091	51,038,682	805,688,594
8th	805,688,594	1,795,477,73	120,853,289	58,694,484	746,994,110
9th	746,994,110	1,795,477,73	112,049,117	67,498,656	679,495,454
10th	679,495,454	1,795,477,73	101,924,318	77,623,455	601,871,999
11th	601,871,999	1,795,477,73	90,280,800	89,266,973	512,605,026
12th	512,605,026	1,795,477,73	76,890,754	102,657,019	409,948,007
13th	409,948,007	1,795,477,73	61,492,201	118,055,572	291,892,435
14th	291,892,435	1,795,477,73	43,783,865	135,763,908	156,128,527
15th	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

Details cost of service :

Table No- 5.24

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 grossamount of fixed assets reported. In these case, we assumed that accumulated Depreciation is zerosince land property.]

5.11 Chart of cost for 50MW Oil based Power Plant :

Table No- 5.25

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-5.26

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.

Comparison between Gas-Based & Oil-Based Power Plant

Cost Type	Gas-based	Oil-based
Unit generating cost	4.55 TK	27.93 TK
Fuel cost	0.98 TK	13.19 TK
Operation & Maintenance cost	0.24 TK	2.60 TK
Depreciation expenses	1.69 TK	5.20 TK
Interest on debt	1.25 TK	4.07 TK
Return on equity	0.29 TK	2.70 TK

5.12 Tariff Rate :

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 2020 as the followings :

SL	Customer Category	Per Unit Rate(Tk)
	Category-A : Residential	
	Life Line : From 0 to 50 units	**3.75**
	a. First Step : From 1 to 75 units	4.19
	b. Second Step : From 76 to 200 units	5.72
1	c. Third Step : From 201 to 300 units	6.00
	d. Fourth Step: From 301 to 400 units	6.34

	e. Fifth Step:	From 401 to 600 units	9.94
	f. Sixth Step:	Above 600 units	11.46
2	Category-B :	Agricultural pumping	4.16

	Category-C : Small Industries		
3	**5.4.1**	Flat Rate	8.53
	5.4.2	Off-Peak Time	7.68
	5.4.3	Peak Time	10.24
4	Ctergory-C(2) : Construction		12.00
	Category-D : Institutions		6.02
	Category-D(2) : Street Light and Water Pumps		7.70
	Category-D(3) : Battery Charging Station		
5	a Flat Rate		7.64
	b Off-Peak Time		6.88
	c Peak Time		6.11
	Category-E : Medium Voltage, General Purpose (11 KV)		
6	a Flat Rate		8.40
	b Off-Peak Time		7.56
	c Peak Time		10.50
	Category-H : High Voltage, General Purpose (33 KV)		
7	a Flat Rate		8.41
	b Off-Peak Time		7.57
	c Peak Time		10.51

5.13 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

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 :

In this thesis paper, we tried to compare economical issues of gas based and oil based power plant. We selected Summit 35 MW as a gas based power plant and Katakhali 50 MW as a oil based power plant. Generating cost is the summation of fuel cost and non-fuel cost. So we determined Fuel cost .For gas based power plant, fuel cost is (0.98 Tk/Kwh) and for oil based power plant, it is (13.19 TK/Kwh). At that point we determined the Service cost. For Service cost estimation we determined Operation and Maintenance cost/costs, Yearly Depreciation (For Depreciation Calculation we calculated Intangible Plant, Production Plant & General Plant) Regulatory Working Capital, ECA Loan Calculation, Commercial Loan Calculation, Return on Equity Calculation. These are the non-fuel cost. The non fuel cost for gas and oil based power plant are (3.57 TK/Kwh) and (14.74 TK/Kwh) respectively. Then we summation the fuel cost and non-fuel cost. We get the complete Generating cost/Indicative cost for gas-based power plant (4.55 Tk/Kwh) and for oil-based power plant (27.93 TK/Kwh). Finally we compared them. We found that Gas-based power plant is cheaper than Oil- based power plant which is important. So, Gas-based power plant is more suitable than Oil-based power plant.

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.

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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