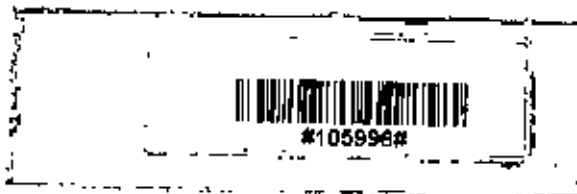# PROFIT OPTIMIZATION IN GAS TRANSMISSION:
CASE OF PURBACHAL PROJECT

By

JANNAT FATEMA

A thesis submitted in partial fulfillment of the requirement for the degree of Master of Advanced Engineering Management
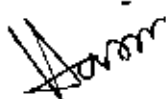
DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA.
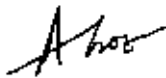
October, 2008

CERTIFICATE OF APPROVAL

The thesis titled "Profit Optimization in Gas Transmission: Case of Purbachal Project" submitted by Jannat Fatema, Roll Number - 100508111(p), session October' 2005, has been accepted as satisfactory in partial fulfillment of the requirements for the degree of Master of Advanced Engineering Management on October 25, 2008.

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It is hereby declared that this project or any part of it has not been submitted elsewhere for the award of any degree or diploma.

_____

(Jannat Fatema)

ABSTRACT

A lot of effort has been directed for gas network design in this country. The proposed gas network will be considered as part of the existing gas pipeline network. One of the objectives of this project work is to identify the parameters affecting economic viability of the Purbachal project, optimize, in terms of profitability, the gas transmission network and evaluate the economic viability of the "Purbachal project". The main outcome of this project is: an inclusive economic analysis report of the "Purbachal Project" which will investigate the financial viability of the project. In this project work, a financial profile has been built for finding net present value (NPV), benefit cost ratio (BCR) and internal rate of return (IRR) on the basis of 20 year project life. The proposed gas network that includes new aspects of designing may be fruitful for new network designing purpose in our gas distribution sector.

ACKNOWLEDGEMENT

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LIST OF ABBREVIATIONS

BCR = Benefit Cost Ratio

IRR = Internal rate of return

PBP = Pay-back period.

NPV = Net Present Value.

BGSL = Bakhrabad Gas Systems limited.

BOGMC = Bangladesh oil gas and mineral corporation.

BGFCL = Bangladesh Gas Fields Company Limited.

JGTDSL = Jalalabad Gas Transmission And Distribution Systems Limited.

PGCL = Pashchimanchal Gas Company Limited

TGTDCL = Titas Gas Transmission And Distribution Company Limited.

CAD = Computer Aided design.

CP = Cathodic Protection

DRS = District Regulating Station.

RMS = Regulating and Metering Station

TBS = Town Bordering Station.

CGS = City Gate Station

MMSCFH = Million Standard Cubic Feet Per Hour

CHAPTER – I

INTRODUCTION

1.1 INTRODUCTION

Natural gas is Bangladesh's only significant source of commercial energy. The Government of Bangladesh estimates that natural gas accounts for 80 percent of the country's commercial energy consumption. Four distribution companies are providing gas supplies to the customers throughout the country; these are Titas Gas T & D Co. Ltd (TGTDCL), Jalalabad Gas T & D Systems Ltd (JGTDSL) Bakhrabad Gas Systems Ltd (BGSL), Pashchimanchal Gas Co. Ltd. (PGCL). Gas consuming sectors of this country are Fertilizer Factories, Power Plants, Industries, Commercial and Domestic etc. A corporate body "Petrobangla" under the Ministry of Petroleum, Energy and Mineral Resources supervise the activities of four separate distribution companies in the country, along with other seven Exploration, Production, Transmission and Mining Companies.

Among the four distribution companies of the country, Titas Gas T & D Co. Ltd. is the pioneer gas company engaged in gas transmission & distribution bussiness. Presently this company is facing difficulties due to the higher "System loss" and "low pressure" of gas in the distribution pipeline network. It is aided by faulty system design, lack of control and monitoring, poor organizational and pay structure of the companies and unplanned growth. The gas distribution Pipeline system of the Company has been built during seventies. With the rapid industrialization, present trend of construction of high rise buildings, the load/demand has increased tremendously, which results inadequate capacity of the present distribution network.

The performance of the proposed gas network, such as efficiency, flow rate, gas regulation, cost and losses etc. vary according to the rating, quality and application of the pipeline. To improve the performance and the quality of the gas network the design of the system should be efficient from the viewpoint of economical and technical aspects.

1.2 BACKGROUND OF THE STUDY

Titas Gas T & D Co. Ltd. (TGTDCL) was formed in November 1964 as a join stock Company (Under the Company's Act 1913) of the central Government of Pakistan the Shell Oil Company, with a view to transmitting and distributing natural gas to the Dhaka city after the discovery of a new gas field called "TITAS" located within the close vicinity of the present Brahmanbaria district of Bangladesh. The authorized capital was Taka 17.8 million only, divided into 17800 shares of Taka 10.00 each.

After the liberation war, certain national priorities were set by the Govt. and significant changes were brought about in the management of development activities. A no. of sector corporations was formed and each of them was entrusted with the operation and management of the units under it. In March 26, 1972 Govt. has formed "Bangladesh Oil, Gas & Mineral Corporation (BOGMC) under the Presidential Executive Order and Titas Gas T & D Co. Ltd. has become an enterprise of BOGMC. Titas Gas T & D Co.Ltd. which was earlier established as a joint stock company with 90 percent share capital of the Govt. of Pakistan naturally vested to the Govt. of the People's Republic of Bangladesh and rest 10 percent share capital of Pakistan Shell Oil Company was transferred to the newly formed Bangladesh Shell Company. During 1975, under the nationalization program, Govt. has brought back 10 percent share of Shell Oil Co. and Titas Gas T & D Co. Ltd. has become a 100 percent Government owned company. Meanwhile, in the year 1974, Bangladesh Oil & Gas Corporation / (Petrobangla) and in the year 1975, Ministry of Energy & Mineral Resources had been formed. TGTDCL has been placed under the administrative control of the newly formed ministry along with Petrobangla and its subsidiary Companies. At present TGTDCL has spread out its network around Dhaka city, greater Dhaka, greater Mymensingh, B-Baria and Tangail district.

On the other hand the population of Dhaka city is increasing at a dreadful rate and the city is expanding rapidly towards Narshingdi, Savar, Gazipur, Jamalpur areas. To resolve the housing problem of Dhaka city dwellers a new project named "Purbachal" has been taken by "RAJUK" to establish a new urban outside Dhaka between Narsigdi and Gazipur

district. To transmit and distribute gas to the proposed new city new gas network has to be set up and Titas Gas T & D Co. Ltd. (TGTDCL) has been given the responsibility for this job. As TGTDCL is a profit seeking organization it must find out whether the project is profitable for the company or not.

1.3   OBJECTIVE OF THE PROJECT

With the rapid industrialization and population growth, country's natural gas requirement has increased to a great extent. The industrial zones are gradually extending in the direction of Bhaluka (Mymensingh) and Mirzapur (Tangail). On the other hand, to resolve the growing housing problem of the Dhaka city dwellers, RAJUK is planning to construct a new residential area at the outskirt of Dhaka city, named Purbachal. TGTDCL has to extend its gas distribution network in "Purbachal". Economic evaluation, in terms of profitability, will be essential prior to construction. This research aims at optimizing the gas transmission and distribution network system and analyzing the feasibility of establishing new gas network at Purbachal.

The objectives of this project are:
a.   Identify the parameters affecting economic viability of the Purbachal project.
b.   Optimize, in terms of profitability, the gas transmission and distribution pipeline network system.
c.   Evaluate the economic viability of the "Purbachal Project".

The main outcomes of this project are: a) an inclusive economic analysis report of the "Purbachal Project" which will investigate the financial viability of the project, b) A study for maximizing profit of "Purbachal Project".

1.4 METHODOLOGY

The project will follow the steps given below:

a. Estimate the scope of Purbachal in terms of area and population.

b. Estimate gas consumption volume.

c. Find out the financial requirements for infrastructure.

d. Find out the constraints for economically optimizing the project.

e. Formulate the Linear Programming model.

f. Find out the economic parameters using suitable engineering economy technique such as IRR, NPV and Payback Period.

CHAPTER-II

NATURAL GAS: BANGLADESH CONTEXT

2.1 NATURAL GAS RESERVE

Natural gas reserve estimates vary widely for Bangladesh. *Oil & Gas Journal (OGJ)* reported that Bangladesh had 5 trillion cubic feet (Tcf) of proven natural gas reserves as of January 2006, down significantly from *OGJ 's* January 2005 estimate of 10.6 Tcf. It is not clear why the large downgrade of Bangladesh's natural gas reserves occurred. In mid-2004, estimates from state-owned Petrobangla put net proven reserves at 15.3 Tcf. Bangladesh's Ministry of Finance estimated in 2004 that the country holds 28.4 Tcf of total gas reserves, of which 20.5 Tcf is recoverable. In June 2001, the U.S. Geological Survey estimated that Bangladesh contains 32.1 Tcf of additional "undiscovered reserves."

While estimates of the country's reserves vary, natural gas is Bangladesh 's only significant source of commercial energy. The government of Bangladesh estimates that natural gas accounts for 80 percent of the country's commercial energy consumption. In 2004, Bangaldesh produced 463 billion cubic feet (Bcf) of natural gas, up from 429 Bcf in 2003 and more than doubling the 1994 level. Despite increasing production levels, Bangladesh has never been a net exporter of natural gas. Given the uncertain size of the country's natural gas reserves, the government has been reluctant to export natural gas and has instead focused on meeting current and future domestic energy needs.

2.2 PRODUCTION & EXPLORATION

Natural gas exploration and production is dominated by three state-owned companies, all of which are subsidiaries of Petrobangla. Bangladesh 's largest gas production company, Bangladesh Gas Fields Company Ltd. (BGFCL), operates the Titas, Bakhrabad, Narsingdi, Habigonj, Feni, Begumganj fields. BGFCL produces roughly half of the country's total natural gas production.

The Sylhet Gas Field Company Ltd. (SGFCL) is Bangladesh's second largest production company, producing 162 MMCFD of natural gas. SGFCL operates.the Sylhet, Kailashtila, Kailashtia, Rashidpur, and Beanibazar gas fields. The third state-owned company involved in natural gas production and exploration is BAPEX, which produces about 58 MMSCFD of natural gas from the Salda and Fenchuganj fields.

To encourage natural gas exploration, the government opened the natural gas sector to foreign investment in 1993, after initiating the First Bidding Round of Production Sharing Contracts. Foreign companies today produce over 6000 MMSCM of natural gas from four gas fields. The leading foreign producer is Chevron, which produces natural gas from the Jalalabad and Moulavibazar and Bibiana fields. The UK's Cairn Energy is the second largest foreign natural gas production company, producing natural gas from Bangladesh's lone offshore gas field at Sangn. Canada's Niko Resources has been involved in disputes with the government after two blowouts that occurred in 2005 at the company's Chattak (formerly known as Tengratila) gas field.

There are several other fields that may prove to hold additional natural gas resources. Petrobangla estimates that the Bibiana field, currently operated by Chevron, may contain as much as 2.4 TCF in recoverable natural gas reserves. Offshore natural gas fields also present large possible reserves, although minimal offshore exploration has occurred to date due to lingering border disputes with India and Myanmar.

	2001	2002	2003	2004	2005	2006	2007	2008
□ PB	8363	8848	9449	9715	10088	10117	10149	7730
▣ Cairn	1355	1380	1466	1480	1341	1573	1128	572
Chevron	856	859	1011	1626	2158	2930	3954	5068
□ Tullow	0	0	0	0	0	76	565	578
□ NIKO	0	0	0	0	198	225	124	45
■ TOTAL	10573	11087	11926	12821	13783	14921	15920	13990
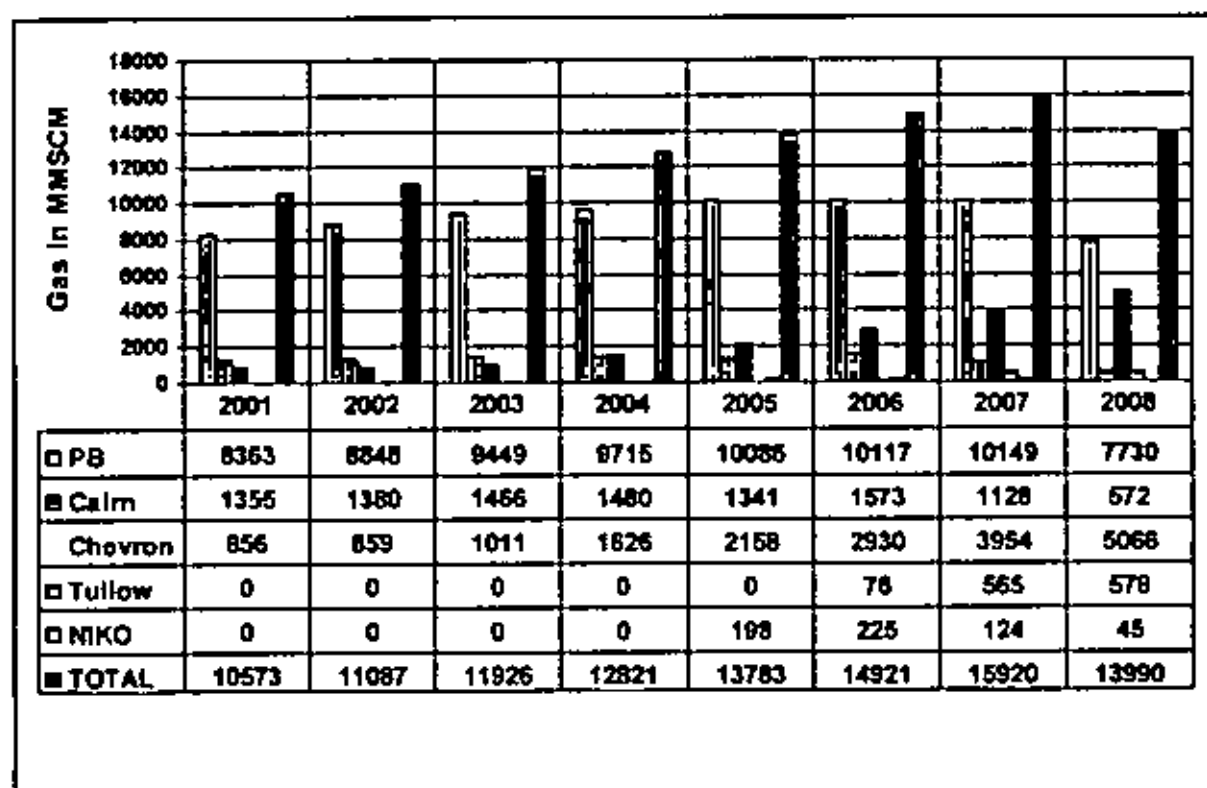
Figure 2.1: Natural Gas Production in Bangladesh (2001-2008)

2.3 PIPELINES

2.3.1 Domestic

Bangladesh's domestic natural Gas Transmission Pipeline Network is operated by the Gas Transmission Company Ltd. (GTCL), a subsidiary of Petrobangla. The company began with the 194 Km pipeline connecting the Kailashtila gas field to Ashuganj. Later GTCL implemented the 65 Km Ashuganj-Bakhrabad pipeline, which completed the interconnection of the national gas grid. GTCL currently operates 770 Km of transmission pipelines and is the sole natural gas transmission company in Bangladesh.

Most of Bangladesh's pipeline network is concentrated in the more populated and developed eastern zone of the country. In 2000, Bangladesh completed a 33 Km pipeline along the Jamuna River, which separates the eastern and western parts of the country. In 2001, this pipeline was extended to the Baghabari Natural Gas-Fired Power Plant, and a

network of pipelines in the west is now starting to take shape. In June 2006, the Government of Bangladesh and the Asian Development Bank (ADB) signed a $230 million loan package to improve Bangladesh's natural gas infrastructure, specifically designed to aid economic development in the western part of the country. According to the ADB, the project includes four gas transmission pipelines, measuring 220 miles, which will transport about 360 MMCFD of natural gas to the 15 million people living in west Bangladesh.

2.3.2 International

Since 1997, Bangladesh has been working to reach an agreement with its neighbors for the establishment of a 560-mile pipeline to transport natural gas from Myanmar to India through its territory. The project has not yet been approved, the fate of which will depend upon India and Myanmar accepting trade concessions and other stipulations. So far, India has not accepted the demands of Bangladesh, and GAIL, India's state-owned pipeline operator, completed a feasibility study in June 2006 of an 870-mile pipeline from Myanmar that would circumvent Bangladesh altogether. However, this option would significantly increase transport costs of natural gas from Myanmar, and the pipeline would have to travel through unstable areas in northeastern India.

CHAPTER-III

LITERATURE REVIEW

3.1 PAY BACK PERIOD

Evaluating capital investments for additions or modifications to warehouses, for replacement of equipment or for entirely new facilities is a complex activity which involves numerous financial, competitive and other considerations. The financial aspect of capital investments is addressed and it is shown how ten different investment criteria can be brought to bear on the capital investment issue. The ten investment criteria consist of five primary criteria and five secondary criteria. The primary criteria are payback period in years, non-discounted rate of return on investment, internal rate of return, Baldwin rate of return, and benefit cost ratio. All ten criteria are described and suggestions are made when each criterion is appropriate. [1]

In response to a call for more research on the "why" of capital budgeting practices, a survey was sent to the Fortune 500 firms to (1) look at the detailed reasons they used particular capital budgeting techniques, (2) to determine if and why they had changed their emphasis on any of those techniques in the last five or ten years, and (3) to explore the importance of strategic considerations in capital budgeting. Detailed reasons and their rankings are given for the choices of payback, discounted payback, accounting rate of return, internal rate of return, modified internal rate of return, profitability index, net present value, and other miscellaneous techniques. [2]

3.2 INTERNAL RATE OF RETURN (IRR)

Examines the problem of multiple solutions in relation to the use of the internal rates of return (IRR) as a decision-making criterion. Attempts to show that positive multiple IRRs occur only in a limited number of cases and in such cases the IRR is not the appropriate measure of return. Argues instead that the true rate of return for such projects is shown to be dependent on the cost of capital. Suggests two methods to deal with this problem: the extended yield method and the return on invested capital method. [3]

Papers by Wyatt (Wyatt, 1984) and Hall (Hall, 1985) have addressed the subject of property performance measurement in this journal, and the topicality of the subject has been ensured by the response to Hager and Lord's paper to the Institute of Actuaries (see Editorial, Journal of Valuation, 3: and Brown, 1985). However, the measure employed has not been the subject of detailed analysis, and at various times the time weighted rate of return, the money weighted rate of return, the internal rate of return and others have been suggested as the appropriate measure. It is not even clear whether MWRR and IRR are identical measures. This paper examines alternative measures and demonstrates the difference between MWRR and IRR and makes recommendations of the correct measure. [4]

3.3 INTERNAL RATE OF RETURN (IRR) AND NET PRESENT VALUE (NPV)

Despite its shortcomings, the IRR method continues to be a widely employed evaluation technique in capital budgeting. This paper demonstrates the reasons for its continued popularity. Specifically, the non-requirement of a discount rate is suggested to be an important factor in the choice of IRR over the NPV criterion. A major implication is that managers face a very elusive, or stochastic, discount rate for NPV analysis. Thus, the aversion to NPV may go beyond simple aesthetics. [5]

Methods of capital budgeting have been well established in the finance literature as well as in corporate practice. In general, the discounted cash flow methods (IRR, NPV, PI) are considered to be superior. An investment project is therefore acceptable (at least in financial terms) when its net present value is positive or its internal rate of return is above the specified cut-off rate. In case of capital rationing, we allocate funds and consequently approve projects in descending order of their profitability index to make sure we obtain the maximum present value per dollar invested. [6]

CHAPTER –IV

DETAILS OF PROPOSED AREA (PURBACHAL)

4.1 BACKGROUND

At present TGTDCL has spread out its network around Dhaka Metropolitan city, greater Dhaka Area, greater Mymensingh Area and B-Baria. On the other hand, recently "RAJUK" has initiated a new project named "Purbachal" to establish a new urban areaoutside Dhaka between Narsingdi and Gazipur district. Titas Gas T & D Co. Ltd. (TGTDCL) has been entrusted with the responsibility of setting up new gas network to transmit and distribute gas to the proposed new city.

Dhaka Metropolitan city has now been turned into the bnsiest & densely popnlated city. Presently about 120 million people reside permanently in Dhaka city, the capital of Bangladesh for service, business and other pnrpose. Dhaka is expected to take new shape of a Mega city within 2005. The dwelling places required for this large number of people are very inadequate. As a result, the residential areas of Dhaka city are turning into overcrowded dirty localities day hy day and creating unhealthy environment causing damage to the natural scenario of the Metropolitan city.

It is possible to reduce the pressure of population of Dhaka city to a great extent by developing the surrounding area of Dhaka city in a planned way and establishing permanent residential accommodation for these vast population. The proposed new residential town will be established in area between Rupganj Upazila of Narayanganj District and Kaligonj Upazila of Gazipur District. The total area of the project is approximately 6150.00 acres. The project area consists of red soils and not so suitable efforts for agriculture and mixed with low lying and hilly undulated land.

4.2 TITAS FRANCHISE AREA (TFA)

TGTDCL has its 20", 16", 12", 8", 6", 4", 3", 2", 1" dia gas network within Dhaka Metropolitan city, Munshigonj, Manikgonj, Narayangonj, Narsingdi, Gazipur, Brahmanbaria, Tangail, Kishoregonj, Mymensingh, Jamalpur, Netrokona, Sherpur. (Figure-4.1)

4.3 DESCRIPTION OF PROPOSED AREA

Proposed "Purbachal New Town Project" is situated at a distance of 16 km from zero point of Dhaka between Rupgonj Upazila of Narayangonj District & Kaligonj Upazila of Gazipur District in between River Balu and Sitalakha.

Objectives of the Project are:

- To reduce the pressure of population in Dhaka city by creating opportunity of residential accommodation of the city dwellers in the vicinity of the city.
- To maintain the balance of environment by proper Urbanization. To create environment friendly and sustainable atmosphere.
- To reduce the existing acute problem of housing.
- To expand civic facilities by urbanization to the near by and surrounding areas gradually.
- Development of new township and to expand economic facilities.
- To mitigate future housing demand.

The project area is divided into thirty sectors. The Purbachal New Town project will connect Dhaka through a six-kilometer eight-lane highway and will house more than 300,000 people. Purbachal land has been divided into four major areas including a residential area of 2,521.92 acres, a commercial area covering 369.59 acres, industrial and institutional areas occupying 123.52 and 129.53 acres, respectively. Rajdhani Unnayan Kartripakkha (Rajuk), the Dhaka City Development Authority, which is in charge of the project, allocated 2,961 plots to non-resident Bangladeshis out of 33,000 in 2003 in an unprecedented move, aiming to inject more foreign currency into the economy. Some parts

of the project site are 20 to 30 feet below normal land level, and the government is filling the area by bringing in soil. Following this, land-leveling and other enabling works will be carried out. The proposed plan of Purbachal New Town is shown in Figure- 4.2.

This will be followed by the construction of a road network, community areas, schools, hospitals, cable network for power supply, gas network for gas supply and a pipeline network to bring water for residents. A network of lakes and parks will complement the landscape.

About 40 per cent of the 33,000 plots have been allocated. The rest will be distributed through a lottery among the applicants who are Bangladeshi citizens. However, according to the commitment; the government gives preference to non-resident Bangladeshis.

More than 10 million people live in Dhaka, Bangladesh's political and commercial capital. Property developer's say the project will help ease the growing housing problem of Dhaka, one of the most densely inhabited cities in the world. Real estate and construction are among the fastest growing sectors in the country. A number of foreign investors including India's Sahara Group is planning to develop townships in large suburbs of Dhaka and Chittagong because the demand for housing will continue to grow.

4.4   DESCRIPTION OF PROPOSED GAS NETWORK

A 20" dia transmission line of 1000 Psig will supply gas to Station -1 which will be the combination of City Gate Station (CGS), Town Bordering Station (TBS), District Regulating Station (DRS). The proposed area for station -1 is Sector - 4. A 300' x 250' land is needed for Station -1.   In proposed CGS, the pressure of the pipeline will be will lowered from 1000 psig to 300 psig. The inlet of TBS will be 300 psig and the outlet will be 150 psig. The pressure of the 150 psig pipeline will be brought down to 50 psig through DRS. For proposed TBS and DRS 100" x 150' land is needed. RAJUK has agreed to allocate necessary land/area for proposed Station -2, Station-3, and Station-4 at Sector 13, 23 and 26. These three stations will be the combination of TBS and DRS. The four stations will act as a source to form a rectangle shape gas pipeline network and will be connected to

each other by 14"DN x 300 psig Distribution Main line. From the four stations 12", 8", 4", 2" dia gas pipeline network will be constructed to form the backbone of gas supply to the customers of the town. The schematic diagram of proposed gas infrastructure is shown in Figure-4.3.

Figure: 4.1 TITAS franchise area

- 16 -
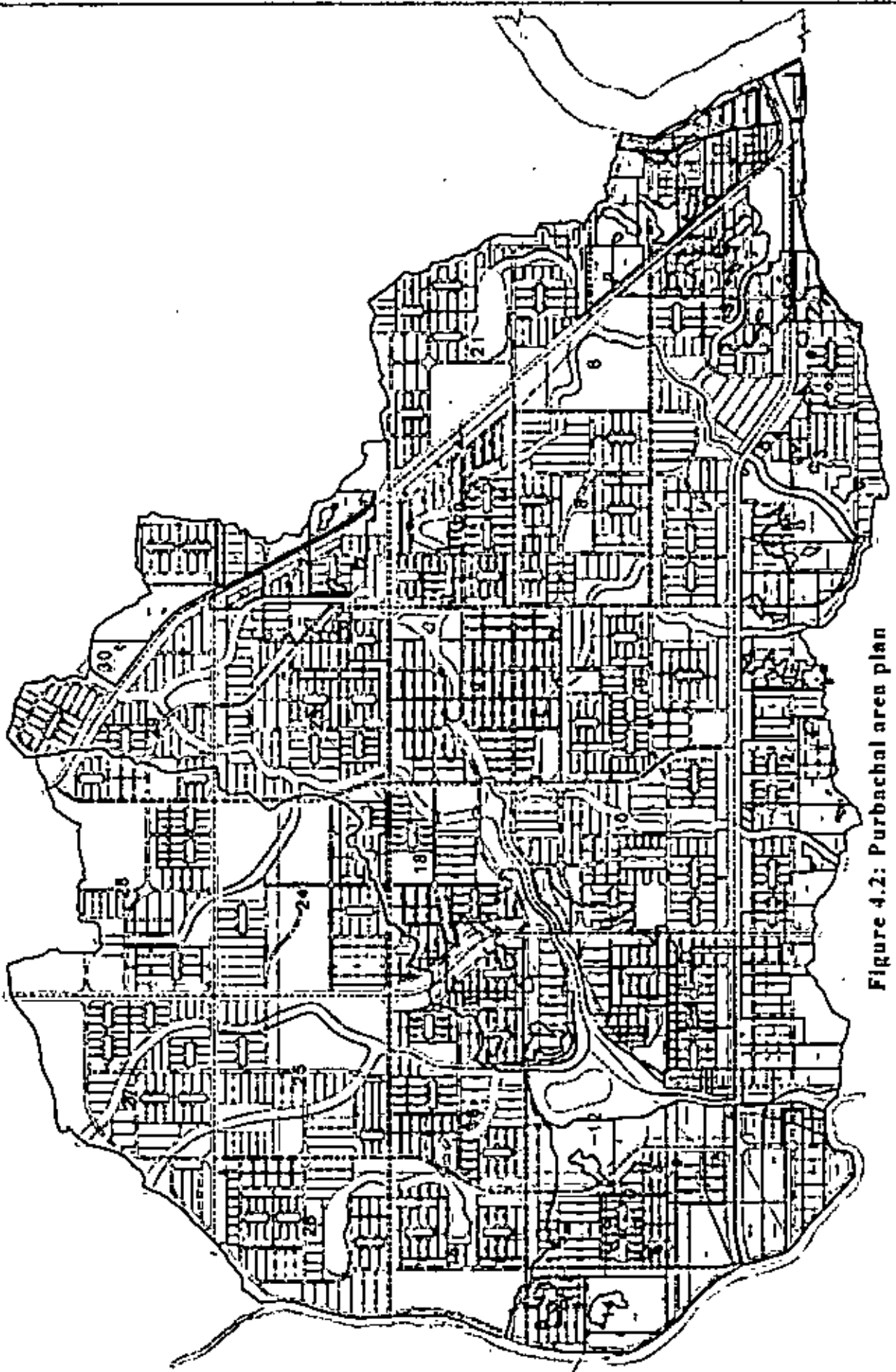
Figure 4.2: Purbachal area plan
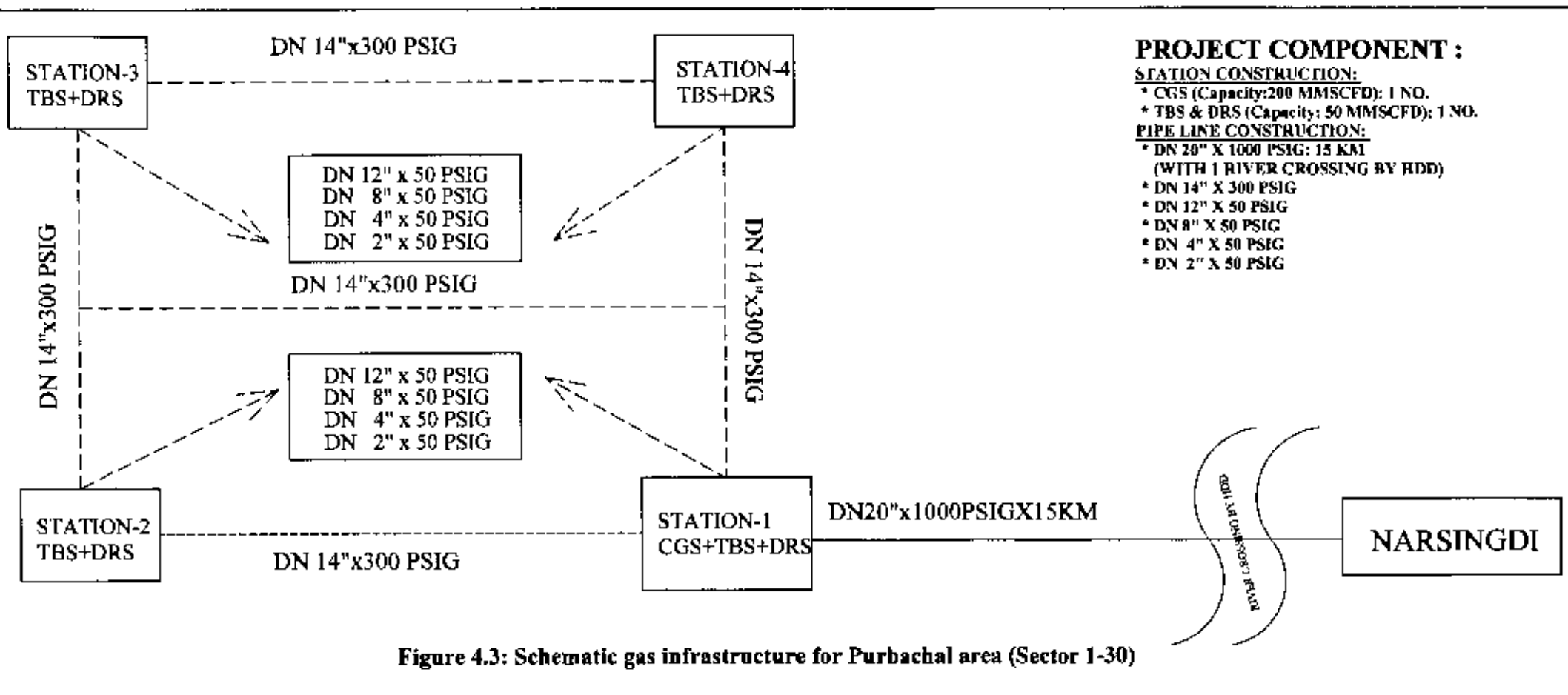
Figure 4.3: Schematic gas infrastructure for Purbachal area (Sector 1-30)

Text within the figure:

DN 14"x300 PSIG

STATION-3
TBS+DRS

STATION-4
TBS+DRS

DN 12" x 50 PSIG
DN 8" x 50 PSIG
DN 4" x 50 PSIG
DN 2" x 50 PSIG

DN 14"x300 PSIG

DN 14"x300 PSIG

DN 14"x300 PSIG

DN 12" x 50 PSIG
DN 8" x 50 PSIG
DN 4" x 50 PSIG
DN 2" x 50 PSIG

STATION-2
TBS+DRS

DN 14"x300 PSIG

STATION-1
CGS+TBS+DRS

DN20"x1000PSIGX15KM

RIVER CROSSING BY HDD

NARSINGDI

PROJECT COMPONENT :
STATION CONSTRUCTION:
* CGS (Capacity:200 MMSCFD): 1 NO.
* TBS & DRS (Capacity: 50 MMSCFD): 1 NO.
PIPE LINE CONSTRUCTION:
* DN 20" X 1000 PSIG: 15 KM
  (WITH 1 RIVER CROSSING BY HDD)
* DN 14" X 300 PSIG
* DN 12" X 50 PSIG
* DN 8" X 50 PSIG
* DN 4" X 50 PSIG
* DN 2" X 50 PSIG

CHAPTER – V

FINANCIAL EVALUTION CRITERION

5.1 INTRODUCTION

The idea of this economic accounting originated with Jules Dupuit, a French engineer whose article in 1848 is still worth reading. The British economist, Alfred Marshall, formulated some of the formal concepts that are at the foundation of CBA (Cost Benefit Analysis). But the practical development of CBA came as a result of the impetus provided by the Federal Navigation Act of 1936. This act required that the U.S. Corps of Engineers carry out projects for the improvement of the waterway system when the total benefits of a project to whomsoever they accrue exceed the costs of that project. Thns, the Corps of Engineers had created systematic methods for measuring such benefits and costs. The engineers of the Corps did this without mnch, if any, assistance from the economics profession. It wasn't until about twenty years later in the 1950's that economists tried to provide a rigorous, consistent set of methods for measuring benefits and costs and deciding whether a project is worthwhile.

5.2 PROFITABILITY ANALYSIS

Soundness of a project from financial standpoint should be checked before going for the construction of the project. Financial analysis of development project deals with review of profitability analysis and cost effectiveness analysis. Profitability analysis will help identify the key variables which influence the project cost and benefit streams.

For long term investment decision making that is for capital budgeting following techniques commonly used :

     i.   Pay-Back Period (PBP)
    ii.   Net Present Value (NPV)
   iii.   Internal Rate of Return (IRR)
   iv.   Benefit Cost Ratio (BCR)

The first three profitability indicators i.e. NPV, BCR and IRR takes into account the relative time value of money and benefit flows through the process of discounting.

5.3   PAY BACK PERIOD

The payback period is the expected number of years to recover the original investment.

Payback Period = (number of required completed years) + Amount required / Cash Flow in the year of full recovery of investment

Example:

Year	Cash flow (Project A)	Cash flow (Project B)
0	(5000)	(5000)
1	2500	600
2	2200	1600
3	1300	2500
4	1000	3100

Payback Period (A) = 2+ 300/1300 = 2.23 Years

Payback Period (B) = 3+300/3100 = 3.097 Years

5.4 TIME VALUE OF MONEY

In the economic or financial analysis of a project, the flows of costs and benefits are basically considered over time. Time, therefore, is an important dimension of any investment decision. Time involves sacrifices in the present over future. The normal expectation would be that benefit accruing in the future should be sufficient to compensate for the sacrifice in the present. The techniques of discounting and compounding are the two basic ways of taking the time value concept of money into consideration.

5.5 NET PRESENT VALUE (NPV)

5.5.1 Concept

NPV is an indicator of how much value an investment or project adds to the value of the firm. With a particular project, if C_t is a positive value, the project is in the status of discounted cash inflow in the time of t. If C_t is a negative value, the project is in the status of discounted cash outflow in the time of t. Appropriately risked projects with a positive NPV could be accepted. In financial theory, if there is a choice between two mutually exclusive alternatives, the one yielding the higher NPV should be selected. The following sums up the NPVs in various situations.

5.5.2 Decision Rule

If...	It means...	Then...
NPV > 0	the investment would add value to the firm	the project may be accepted
NPV < 0	the investment would subtract value from the firm	the project should be rejected
NPV = 0	the investment would neither gain nor lose value for the firm	We should be indifferent in the decision whether to accept or reject the project. This project adds no monetary value. Decision should be based on other criteria.

However, NPV = 0 does not mean that a project is only expected to break even, in the sense of undiscounted profit or loss (earnings). It will show net total positive cash flow and earnings over its life.

Net present value (NPV) is a standard method for the financial appraisal of long-term projects. Used for capital budgeting, and widely throughout economics, it measures the excess or shortfall of cash flows, in present value (PV) terms, once financing charges are met. By definition,

NPV = Present value of net cash flows.

Formula:
Each cash inflow/outflow is discounted back to its PV. Then they are summed.

The Net Present Value (NPV) of a whole income stream is the sum of these present values of the individual amounts in the income stream. If we still assume that income comes or goes in annual bursts and that the discount rate will be constant in the future, then the NPV has this formula:

Where,

$$NPV = \sum_{i=0}^{n} \frac{b_i - c_i}{(1+r)i} \tag{5.1}$$

$$NPV = \frac{b_0 - c_0}{(1+r)^0} + \frac{b_1 - c_1}{(1+r)^1} + \frac{b_2 - c_2}{(1+r)^2} + \ldots\ldots + \frac{b_n - c_n}{(1+r)^n}$$

b_i = benefits derived from the project in year i.

c_i = Cost (investment, operating and other associated expenses)
           Incurred by the project in year i.

r = discount rate

I = time period which runs from year zero to year n.

5.6 DISCOUNTING

5.6.1 Discount Rate

The rate used to discount future cash flows to their present values is a key variable of this process. Many people believe that it is appropriate to use higher discount rates to adjust for risk for riskier projects.

NPV value obtained using variable discount rates (if they are known) with the years of the investment duration better reflects the real situation than that calculated from a constant discount rate for the entire investment duration.

To some extent, the selection of the discount rate is dependent on the use to which it will be put. If the intent is simply to determine whether a project will add value to the company, using the firm's weighted average cost of capital may be appropriate. If trying to decide between alternative investments in order to maximize the value of the firm, the corporate reinvestment rate would probably be a better choice.
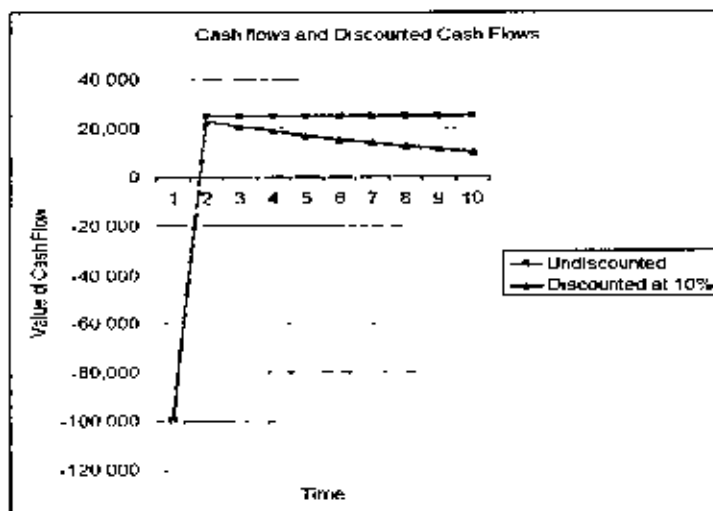
Figure 5.1 Cash flows and discounted cash flows

The discounted present value may be derived through the formula:

$$P_0 = P_N \frac{1}{(1 + r)^n}$$

(5.2)

Where,

P_n =   Present value

P_0 =   expected revenue at some future year, N

r =   discount rate, and

n =   the discounting period.

5.7 INTERNAL RATE OF RETURN (IRR)

5.7.1 Concept

The internal rate of return (IRR) is a capital budgeting metric used by firms to decide whether they should make investments. It is an indicator of the efficiency of an investment, as opposed to net present value (NPV), which indicates value or magnitude.

The Internal Rate of Return (IRR) is the discount rate that generates a zero net present value for a series of future cash flows i.e. it is the discount rate that equates the present values of project's benefits and costs. IRR does not depend upon externally given social rate of discount. Conversely, what it represents is essentially the average earning power of money used in project over the project life. The commonly used formula (approved by Planning Commission, Ministry of Planning) for calculating IRR is:

$$IRR = S + (N / N+M) \times (P-S)$$

(5.3)

Where,

S = Lower rate of discount at which NPV is (+)

P= Higher rate of discount at which NPV is (-)

N= NPV at lower rate of discount rate

M = Absolute NPV at higher rate of discount rate

This essentially means that IRR is the rate of return that makes the sum of present value of future cash flows and the final market value of a project (or an investment) equal its current market value.

The IRR is the annualized effective compounded return rate which can be earned on the invested capital, i.e., the yield on the investment.

A project is a good investment proposition if its IRR is greater than the rate of return that could be earned by alternative investments (investing in other projects, buying bonds, even putting the money in a bank account). Thus, the IRR should be compared to an alternative cost of capital including an appropriate risk premium.

Mathematically the IRR is defined as any discount rate that results in a net present value of zero of a series of cash flows.

In general, if the IRR is greater than the project's cost of capital, or *hurdle rate*, the project will add value for the company.

Method

To find the internal rate of return, find the value(s) of r that satisfies the following equation:

$$NPV = C_0 + \sum_{t=1}^{N} \frac{C_t}{(1+r)^t} = 0$$

(5.4)

Example:

Year	0	1	2	3	4
Cash Flow	-100	+30	+35	+40	+45

$$NPV = -100 + \frac{30}{(1+r)^1} + \frac{35}{(1+r)^2} + \frac{40}{(1+r)^3} + \frac{45}{(1+r)^4} = 0 \Rightarrow r \approx 17.09$$

IRR = r,

IRR = 17.09%

- 25 -

.

Net Present Value (NPV)

Thus using r = IRR = 17.09%,

$$NPV = -100 + \frac{30}{(1 + 17.09\%)^1} + \frac{35}{(1 + 17.09\%)^2} + \frac{40}{(1 + 17.09\%)^3} + \frac{45}{(1 + 17.09\%)^4} = 0.00$$

5.7.2 Decision Rule

In cases where one project has a higher initial investment than a second mutually exclusive project, the first project may have a lower IRR (expected return), but a higher NPV (increase in shareholders' wealth) and should thus be accepted over the second project (assuming no capital constraints).

IRR makes no assumptions about the reinvestment of the positive cash flow from a project. As a result, IRR should not be used to compare projects of different duration and with a different overall pattern of cash flows.

The IRR method should not be used in the usual manner for projects that start with an initial positive cash inflow (or in some projects with large negative cash flows at the end), for example where a customer makes a deposit before a specific machine is built, resulting in a single positive cash flow followed by a series of negative cash flows (+ - - - -). In this case the usual IRR decision rule needs to be reversed.

If there are multiple sign changes in the series of cash flows, e.g. (- + - + -), there may be multiple IRRs for a single project, so that the IRR decision rule may be impossible to implement. Examples of this type of project are strip mines and nuclear power plants, where there is usually a large cash outflow at the end of the project.

Despite a strong academic preference for NPV, surveys indicate that executives prefer IRR over NPV. Apparently, managers find it easier to compare investments of different sizes in terms of percentage rates of return than by dollars of NPV. However, NPV remains the "more accurate" reflection of value to the business. IRR, as a measure of investment

efficiency may give better insights in capital constrained situations. However, when comparing mutually exclusive projects, NPV is the appropriate measure.

5.8   BENEFIT-COST RATIO (BCR)

5.8.1 Concept

A Benefit-Cost Ratio (BCR) is an indicator, used in the formal discipline of cost-benefit analysis, that attempts to summarize the overall value for money of a project or proposal. A BCR is the ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms. All benefits and costs should be expressed in discounted present values.

In the absence of funding constraints, the best value for money projects is those with the highest net present value. Where there is a budget constraint, the ratio of NPV to the expenditure falling within the constraint should be used. In practice, the ratio of NPV to expenditure is expressed as a BCR. BCRs have been used most extensively in the field of transport cost-benefit appraisals.

The Benefit-Cost Ratio (BCR) is derived by dividing present value benefit (PVB) by present value cost (PVC) i.e. BCR = PVB/PVC. The benefit cost ratio indicates benefit per taka of cost.

5.8.2 Decision Rule

If BCR is more than one, that is discounted present value of the benefits exceeds the discounted present value of the costs, investment in the project is worthwhile. This is equivalent to the condition that the net benefit must be positive. Net Present Value and benefit cost ratio may not provide the same ranking of the projects. In an investment decision, therefore, selection of investment criteria is important. As long as we are concerned with a single project or two or more projects whose costs are the same the NPV criterion is adequate. But in a situation with differing costs, BCR provides a relative measure of worthwhile ness to the project.

Formula:

$$BCR = \frac{\sum_{i=0}^{n} \dfrac{b_i}{(1+r)i}}{\sum_{j=0}^{n} \dfrac{c_i}{(1+r)i}} = \frac{PVB}{PVC}$$

Where,

b_i =   benefits in derived .

c_i =   Cost in period i.

r =   discount rate

n =   Discounting period.

PVB   =   Present value Benefit.

PVC   =   Present value Cost.

If there are more than one mutually exclusive project that have positive net present value then there has to be further analysis. From the set of mutually exclusive projects the one that should be selected is the one with the highest net present value.

The magnitude of the ratio of benefits to costs is to a degree arbitrary because some costs such as operating costs may be deducted from benefits and thus not be included in the cost figure. This is called *netting out* of operating costs. This netting out may be done for some projects and not for others. This manipulation of the benefits and costs will not affect the net benefits but it may change the benefit/cost ratio. However it will not raise the benefit cost ratio which is less than one to above one.

CHAPTER-VI

INVESTMENT COST

6.1 INVESTMENT COST SUMMARY

The investment cost of this project is consists of 15 Km Transmission component, 20 Km Distribntion Main component, 786 Km Distribution component, Four stations for Regulating and Metering and a River Crossing by Horizontal Directional Drilling (HDD) Method. A cost estimate has been made using the rates of the previous projects undertaken by the Company. The summary of the project costing is shown in Table 6.1.

6.2 TRANSMISSION COMPONENT

The Transmission component of Purbachal Project consists of 15 km Transmission Pipeline (20" DN x 1000 Psig) and 20 km Distribution Main Pipeline (14" DN x 300 Psig). The 20 Km Transmission pipeline will transmit gas from Narshingdi Valve Station -12 to proposed CGS at Purbachal. On the basis of the experience of the other projects varions elements and costs of the transmission and distribution main component are projected. The costing of Transmission and Distribution Main component is shown in Table 6.2 and the detail calculation of this component is shown in Table 6.3.

Table 6.1: Preliminary project costing summary

GROUP- A: STATION CONSTRUCTION

(in lakh Taka)

SL. NO.	COMPONENT	QUANTITY		UNIT RATE	TOTAL AMOUNT
1	CGS (Capacity: 200 MMSCFD)				
a	Material Cost	1	Nos.	150.00	150.00
b	Construction Cost	1	Nos.	30.00	30.00
2	TBS/DRS (Capacity: 50 MMSCFD Each)				
a	Material Cost	3	Nos.	100.00	300.00
b	Construction Cost	3	Nos.	20.00	60.00
				TOTAL (GROUP A):	540.00

GROUP- B: RIVER CROSSING BY HDD METHOD

SL. NO.	COMPONENT	QUANTITY		UNIT RATE	TOTAL AMOUNT
1	SHITALAKHAYA RIVER CROSSING				
a	Shitalakhaya River Crossing by HDD method (adding 10% contingency)		LOT		482.35
				TOTAL (GROUP B):	482.35

GROUP- C: PIPELINE CONSTRUCTION

SL. NO.	COMPONENT	QUANTITY		UNIT RATE	TOTAL AMOUNT
1	Transmission Pipeline: (20" x 1000 Psig x 15 km)				
	Distribution Main Pipeline: (14" x 300 Psig x 20 km)				
a	Land Acquistion (Katha), 15 km x 20'	23	acres	10.00	230.00
b	Land Requistion (Katha), 15 km x 30'	35	acres	3.00	105.00
c	Road Restoration Charge	12200	sqm.		186.81
d	Material Cost		LOT		4,582.39
e	Construction Cost	35000	M		1,396.48
f	Other Cost		L.S.		15.00
				SUB-TOTAL (C.1):	6,515.68
2	Feeder Main Pipeline: (12" x 50 Psig x 274km)				
	Distribution Pipeline: (8" x 50 Psig x 90 km)				
	Distribution Pipeline: (4" x 50 Psig x 62 km)				
	Distribution Pipeline: (2" x 50 Psig x 360 km)				
a	Road Restoration Charge	479460	sqm.		4,125.89
b	Material Cost		LOT		28,909.34
c	Construction Cost	50000	m	320.00	1,682.15
				SUB-TOTAL (C.2):	34,717.38
				TOTAL (GROUP - C):	41,233.06
				TOTAL (A+B+C):	42,255.41
				4% Contingency (excluding Group B)	1,670.92
				GRAND TOTAL:	43,926.33

Table 6.2: Costing for Transmission and Distribution main component

(in Lakh Taka)

A. PRE CONSTRUCTION EXPENDITURE	Local	Foreign	Total
1 Land Acquisition	230 00	-	230.00
2 Land Requisition	105 00	-	105.00
3. Survey/Design/Drawing etc	10.00	-	10.00
4. IEE/EIA	5.00	-	5.00
SUB - TOTAL (A):	350.00	-	350.00

B. MATERIAL COST	Local	Foreign	Total
1. Line Pipe		1,717.50	1,717.50
2. Valves & Fittings	-	601.13	601.13
3. Tape & Primer	-	343.50	343.50
4. Station Matetials (1 CGS + 3 TBS/DRS)	-	450.00	450.00
5. CP Materials	-	20.00	20.00
6. CD/VAT	1,566.06	-	1,566.06
7. Pre-shipment Inspection	-	5.32	5.32
8 Landing, Transportation and Storage cost	156 61	-	156.61
9. Miscellaneous Charges Relating to Foreign Procurement	172.27	-	172 27
SUB - TOTAL (B):	1,894.94	3,137.45	5,032.39

C. CONSTRUCTION COST :	Local	Foreign	Total
1 Laying Cost	925.00	-	925.00
2 Welding Cost	104.55	-	104.55
3. Highway/Railway Crossing	10.00	-	10.00
4. Canal/Khal Crossing	20.00	-	20.00
5. TBS/DRS Construction	90.00	-	90 00
6. Civil Construction DRS Foundation, Boundary Wall	77.20	-	77 20
7. CP Construction	20.00	-	20.00
8. Road Restoration	186.81	-	186.81
SUB - TOTAL (C):	1,433.56	-	1,433.56
TOTAL (A+B+C) :	3,678.49	3,137.45	6,815.94
Adding 4% Contingency	147.14	125.50	272 64
TOTAL INVESTMENT COST :	3,825.63	3,262.95	7,088.58

Table 6.3 Detail calculation (Transmission & Distribution main component)

(in Lakh Taka)

Description	Area/Unit	Unit Price	Local	Foreign	Total
1) PRE-CONSTRUCTION EXPENDETURE					
Land Acquistion (Katha), 15 km x 20'	23.00	10.00	230.00	-	230.00
Land Requistion (Katha), 15 km x 30'	35.00	3.00	105.00	-	105.00
Survey/Design/Drawing etc.	L.S	.	10.00	-	10.00
EIA	L.S	L.S	5.00	-	5.00
Soil Investigation	L.S	L.S	-	-	-
		Sub-Total=	350.00	-	350.00
2) MATERIALS					
(a) Line Pipe:	Length	Unit Price	Local	Foreign	Total
Local Procurement					
8" DN	0	3,187.00	-	-	-
6" DN	0	2,030.00	-	-	-
4" DN	0	1,267.00	-	-	-
3" DN	0	732.00	-	-	-
2" DN	0	518.00	-	-	-
1" DN	0	221.00	-	-	-
sub total =	0		-	-	-
(b)Imported Procurement	Length	Unit Price	Local	Foreign	Total
20" DN	15000	6,650.00	-	997.50	997.50
14" DN	20000	3,600.00	-	720.00	720.00
12" DN	0	2,800.00	-	-	-
10" DN	0	1,335.00	-	-	-
sub total =	35000		-	1,717.50	1,717.50
3)CONSTRUCTION :					
i) Pipeline Laying	Length	Unit Price	Local	Foreign	Total
20" DN x 1000 PSIG	15000	3,500.00	525	-	525.00
14" DN x 300 PSIG	20000	2,000.00	400	-	400.00
12" DN x 50 PSIG	0	155.79	0	-	-
10" DN	0	151.82	-	-	-
8" DN	0	101.66	-	-	-
6" DN	0	97.32	-	-	-
4" DN	0	68.26	-	-	-
3" DN	0	62.07	-	-	-
2" DN	0	47.30	-	-	-
1" DN	0	45.47	-	-	-
Sub-Total=	0		925.00	-	925.00
ii) Pipe Welding	Nos.	Unit Price	Local	Foreign	Total
24" DN Casing Pipe	50	4,000.00	2.00	-	2.00
20" DN x 1000 PSIG	1663	3,500.00	58.21	-	58.21
14" DN x 300 PSIG	2217	2,000.00	44.34	-	44.34
12" DN	0	315.00	-	-	-
10" DN	0	263.48	-	-	-
8" DN	0	237.71	-	-	-
6" DN	0	176.56	-	-	-
4" DN	0	118.50	-	-	-
3" DN	0	103.92	-	-	-
2" DN	0	86.58	-	-	-
1" DN	0	65.49	-	-	-
		Sub-Total=	104.55	-	104.55
4) OTHERS					-
i) Road Breaking & Prov. Reinstatement					-
Brick paving	0	68.34	-	-	-
Asphalt paving	0	49.28	-	-	-
CC/RCC	0	59.75	-	-	-
		Sub-Total=	-	-	-
5) ROAD RESTORATION				-	-
Brick Paving	0	618.00	-	-	-
Asphalt Paving	21350	875.00	186.81	-	186.81
CC/RCC	0	1,003.00	-	-	-
Kutcha	0	65.00	-	-	-
		Sub-Total=	186.81	-	186.81
6) CIVIL CONSTRUCTION					
I) TBS/DRS foundation	L.S		40.00	0.00	40.00
ii) Functional/operational bldg	-	-	30.00	-	30.00
iii) boundary wall with earth retaining measures, Rft	400	1,500.00	6.00	-	6.00
iv) Guard room	L.S	30,000.00	1.20	-	1.20
		Sub-Total=	77.20	0.00	77.20

6.3 DISTRIBUTION COMPONENT

The Distribution component consists of 274 km Feeder Main Pipeline (12" DN x 50 Psig), 90 km Distribution Pipeline (8" DN x 50 Psig), 62 km Distribution Pipeline (4" DN x 50 Psig) and 360 km Distribution Pipeline (2" DN x 50 Psig). The projected costing of Distribution component is shown in Table 6.4, 6.6, 6.8 and the detail calculation of this component is shown in Table 6.5, 6.7 and 6.9. In order to find out the length of different diameter gas pipeline needed for the area, the road length and width have been measured from the detailed Project Plan of Purbachal (Figure 4.2). The length calculation of Sector 1-10 is shown in Table-6.11, Sector 11-20 is shown in Table-6.12, Sector 21-30 is shown in Table-6.13.

Table 6.4: Costing for distribution component (Sector 1 - 10)

(in Lakh Taka)

A. MATERIAL COST	Local	Foreign	Total
1. Line Pipe	1,630.47	2,044.00	3,674.47
2. Valves & Fittings	-	1,286.06	1,286.06
3. Tape & Primer	-	734.89	734.89
5 CP Materials	-	10.00	10.00
6. Valve Pit Cover	63.73	-	63.73
7 CD/VAT	2,037.48	-	2,037.48
8 Pre-shipment Inspection	-	6.93	6.93
9. Landing, Transportation and Storage cost	203.75	-	203.75
10. Miscellaneous Charges Relating to Foreign Procurement	224.12	-	224.12
SUB - TOTAL (A):	4,159.55	4,081.89	8,241.43

B. CONSTRUCTION COST :	Local	Foreign	Total
1. Laying Cost	207.21	-	207.21
2. Welding Cost	57.65	-	57.65
3. Highway/Railway Crossing	12.37	-	12.37
4. Canal/Khal Crossing	16.30	-	16.30
5. Valve Pit Construction	117.20	-	117.20
6. Breaking & Provisional Reinstatement	115.81	-	115.81
7. CP Construction	10.00	-	10.00
SUB - TOTAL (B):	536.54	-	536.54

C. ROAD RESTORATION CHARGE	Local	Foreign	Total
(Payable to Road Owning Agency)	1,254.31	-	1,254.31
SUB - TOTAL (C):	1,254.31	-	1,254.31

	Local	Foreign	Total
TOTAL (A+B+C) :	5,950.40	4,081.89	10,032.28
Adding 4% Contingency:	238.02	163.28	401.29
TOTAL INVESTMENT COST :	6,188.41	4,245.16	10,433.57

No. of Roads   :   657
No. of Valve Pits   :   657

Table 6.5: Detail calculation (Distribution network sector 1-10)

1) MATERIALS (in Lakh Taka)

(a) Line Pipe:	Length	Unit Price	Local	Foreign	Total
Local Procurement					
8" DN	26000	3,187 00	828.62	-	828.62
6" DN	0	2,030.00	-	-	-
4" DN	13000	1,267.00	164 71	-	164.71
3" DN	0	732.00	-	-	-
2" DN	123000	518 00	637 14	-	637.14
1" DN	0	221.00	-	-	-
Sub total =	162000		1,630.47	-	1,630.47
(b) Imported Procurement	**Length**	**Unit Price**	**Local**	**Foreign**	**Total**
24" DN	0	8,000.00	-	-	-
20" DN	0	6,650 00	-	-	-
14" DN	0	3,600.00	-	-	-
12" DN	73000	2,800.00	-	2,044.00	2,044.00
10" DN	0	1,335.00	-	-	-
Sub total =	73000		-	2,044.00	2,044.00

2)CONSTRUCTION (50 PSIG NETWORK):

i) Pipeline Laying	Length	Unit Price	Local	Foreign	Total
20" DN x 1000 PSIG	0	3,500.00	-	-	-
14" DN x 300 PSIG	0	2,000.00	0	-	-
12" DN x 50 PSIG	73000	155.79	113.73	-	113.73
10" DN	0	151.82	-	-	-
8" DN	26000	101 66	26 43	-	26.43
6" DN	0	97.32	-	-	-
4" DN	13000	68.26	8.87	-	8.87
3" DN	0	62 07	-	-	-
2" DN	123000	47 30	58.18	-	58.18
1" DN	0	45.47	-	-	-
Sub-Total=	162000		207.21	-	207.21
II) Pipe Welding	**Nos.**	**Unit Price**	**Local**	**Foreign**	**Total**
24" DN Casing Pipe	0	4,000 00	-	-	-
20" DN x 1000 PSIG	0	3,500.00	-	-	-
14" DN x 300 PSIG	0	2,000 00	-	-	-
12" DN	8091	315 00	25.49	-	25.49
10" DN	0	263 48	-	-	-
8" DN	2882	237.71	6.85	-	6.85
6" DN	0	176.56	-	-	-
4" DN	1441	118 50	1.71	-	1.71
3" DN	0	103.92	-	-	-
2" DN	27265	86 58	23.61	-	23.61
		Sub-Total=	57.65	-	57.65

3) OTHERS

iii) Khal, Canal, Culvert Crossing	1630	1,000 00	16 30	-	16.30
iv) Highway Crossing	1000	1,237 00	12 37	-	12.37
v) River Crossing (2 nos.)	0	20,000 00	-		-
v) Valve Pit Construction					-
a) 4"& below	357	13,500 00	48 20	-	48 20
b) above 4"	300	23,000.00	69.00	-	69.00
vi) Road Breaking & Prov. Reinstatement					-
Brick paving	0	68 34	-	-	-
Asphalt paving	235000	49 28	115.81	-	115 81
CC/RCC	0	59.75	-	-	-
			115.81		115.81
		Sub-Total=	261.67	-	261.67

4) ROAD RESTORATION

				-	-
Brick Paving	0	618.00	-	-	-
Asphalt Paving	143350	875.00	1,254.31	-	1,254 31
CC/RCC	0	1,003.00	-	-	-
Kutcha	0	65.00	-	-	-
		Sub-Total=	1,254.31	-	1,254.31

Table 6.6: Costing for distribution component (Sector 11-20)

(In Lakh Taka)

A. MATERIAL COST	Local	Foreign	Total
1. Line Pipe	1,442 99	1,540.00	2,982.99
2. Valves & Fittings	-	1,044.05	1,044.05
3 Tape & Primer	-	596 60	596.60
5 CP Materials	-	10 00	10.00
6. Valve Pit Cover	46.95	-	46.95
7. CD/VAT	1,595.32	-	1,595.32
8. Pre-shipment Inspection	-	5 42	5.42
9. Landing, Transportation and Storage cost	159.53	-	159.53
10. Miscellaneous Charges Relating to Foreign Procurement	175.49	-	175.49
SUB - TOTAL (A):	3,420.28	3,196.07	6,616.35

B. CONSTRUCTION COST :	Local	Foreign	Total
1. Laying Cost	168 66	-	168.66
2. Welding Cost	45.67	-	45.67
3. Highway/Railway Crossing	12.37	-	12.37
4. Canal/Khal Crossing	14 00	-	14.00
5. Valve Pit Construction	84 34	-	84.34
6. Breaking & Provisional Reinstatement	96.59	-	96.59
7. CP Construction	10.00	-	10.00
SUB - TOTAL (B):	431.63	-	431.63

C. ROAD RESTORATION CHARGE	Local	Foreign	Total
(Payable to Road Owning Agency)	1,046 15	-	1,046.15
SUB - TOTAL (C):	1,046.15	-	1,046.15

	Local	Foreign	Total
TOTAL (A+B+C) :	4,898.06	3,196.07	8,094.13
Adding 4% Contingency	195.92	127.84	323.77
TOTAL INVESTMENT COST :	5,093.98	3,323.91	8,417.89

No of Road: 484
No. of Valve pit: 484

Table 6.7 Detail calculation (Distribution network sector 11-20)

(in Lakh Taka)

1) MATERIALS

(a) Line Pipe:	Length	Unit Price	Local	Foreign	Total
Local Procurement					
8" DN	18000	3,187.00	573 66	-	573 66
6" DN	0	2,030.00	-	-	-
4" DN	31000	1,267 00	392.77	-	392.77
3" DN	0	732 00	-	-	-
2" DN	92000	518.00	476.56	-	476 56
1" DN	0	221.00	-	-	-
Sub total =	141000		1,442.99	-	1,442.99
(b) Imported Procurement	Length	Unit Price	Local	Foreign	Total
24" DN	0	8,000.00	-	-	-
20" DN	0	6,650.00	-	-	-
14" DN	0	3,600.00	-	-	-
12" DN	55000	2,800.00	-	1,540.00	1,540 00
10" DN	0	1,335.00	-	-	-
Sub total =	55000		-	1,540.00	1,540.00

2) CONSTRUCTION (50 PSIG NETWORK):

I) Pipeline Laying	Length	Unit Price	Local	Foreign	Total
20" DN x 1000 PSIG	0	3,500.00	0	-	-
14" DN x 300 PSIG	0	2,000 00	0	-	-
12" DN x 50 PSIG	55000	155 79	85.6845	-	85.68
10" DN	0	151,82	-	-	-
8" DN	18000	101.66	18.30	-	18 30
6" DN	0	97.32	-	-	-
4" DN	31000	68.26	21.16	-	21 16
3" DN	0	62 07	-	-	-
2" DN	92000	47 30	43.52	-	43 52
1" DN	0	45 47	-	-	-
Sub-Total=	141000		168.66	-	168.66
II) Pipe Welding	Nos.	Unit Price	Local	Foreign	Total
24" DN Casing Pipe	0	4,000 00	-	-	-
20" DN x 1000 PSIG	0	3,500 00	-	-	-
14" DN x 300 PSIG	0	2,000.00	-	-	-
12" DN	6096	315.00	19 20	-	19.20
10" DN	0	263.48	-	-	-
8" DN	1995	237 71	4.74	-	4.74
6" DN	0	176 56	-	-	-
4" DN	3436	118.50	4.07	-	4.07
3" DN	0	103 92	-	-	-
2" DN	20394	86 58	17.66	-	17 66
1" DN	0	65.49	-	-	-
		Sub-Total=	45.67	-	45.67

3) OTHERS

iii) Khal, Canal, Culvert Crossing	1400	1,000.00	14.00	-	14 00
iv) Highway Crossing	1000	1,237 00	12.37	-	12.37
v) River Crossing (2 nos.)	0	20,000.00	-		-
v) Valve Pil Construction					-
a) 4"& below	284	13,500 00	38 34	-	38.34
b) above 4"	200	23,000.00	46.00	-	46.00
vi) Road Breaking & Prov. Reinstatement					-
Brick paving	0	68 34	-	-	-
Asphalt paving	196000	49.28	96 59	-	96.59
CC/RCC	0	59.75	-	-	-
			96.59		96.59

4) ROAD RESTORATION

					-
Brick Paving	0	618 00	-	-	-
Asphalt Paving	119560	875 00	1,046 15	-	1,046.15
CC/RCC	0	1,003.00	-	-	-
Kutcha	0	65.00	-	-	-
		Sub-Total=	1,046.15	-	1,046.15

Table 6.8: Costing for distribution component (Sector: 21 TO 30)

(In Lakh Taka)

A. MATERIAL COST	Local	Foreign	Total
1. Line Pipe	2,260.49	3,920.00	6,180.49
2. Valves & Fittings	-	2,163.17	2,163.17
3. Tape & Primer	-	1,236.10	1,236.10
4. CP Materials	-	10.00	10.00
5. Valve Pit Cover	15.13	-	15.13
6. CD/VAT	3,664.63	-	3,664.63
7 Pre-shipment Inspection	-	12.46	12.46
8. Landing, Transportation and Storage cost	366.46	-	366.46
9 Miscellaneous Charges Relating to Foreign Procurement	403.11	-	403.11
SUB - TOTAL (A):	6,709.83	7,341.73	14,051.56

B. CONSTRUCTION COST :	Local	Foreign	Total
1. Laying Cost	297.61	-	297.61
2. Welding Cost	78.81	-	78.81
3. Highway/Railway Crossing	12.37	-	12.37
4 Canal/Khal Crossing	25.00	-	25.00
5. Valve Pit Construction	121.65	-	121.65
6 Breaking & Provisional Reinstatement	168.54	-	168.54
7. CP Construction	10.00	-	10.00
SUB - TOTAL (B):	713.98	-	713.98

C. ROAD RESTORATION CHARGE	Local	Foreign	Total
(Payable to Road Owning Agency)	1,825.43	-	1,825.43
SUB - TOTAL (C):	1,825.43	-	1,825.43

	Local	Foreign	Total
TOTAL (A+B+C) :	9,249.23	7,341.73	16,590.96
Adding 4% Contingency:	369.97	293.67	663.64
TOTAL INVESTMENT COST :	9,619.20	7,635.40	17,254.60

No. of Roads   : 690
No. of Valve Pits   : 690

Table 6.9: Detail calculation (Distribution network sector 21-30)

(in Lakh Taka)

1) MATERIALS

(a) Line Pipe:	Length	Unit Price	Local	Foreign	Total
Local Procurement					
8" DN	41000	3,187.00	1,306.67	-	1,306 67
6" DN	0	2,030 00	-	-	-
4" DN	16000	1,267.00	202.72	-	202 72
3" DN	0	732.00	-	-	-
2" DN	145000	518 00	751.10	-	751.10
1" DN	0	221 00	-	-	-
Sub total =	202000		2,260.49	-	2,260.49
(b)Imported Procurement	Length	Unit Price	Local	Foreign	Total
24" DN	0	8,000.00	-	-	-
20" DN	0	6,650.00	-	-	-
14" DN	0	3,600.00	-	-	-
12" DN	140000	2,800.00	-	3,920 00	3,920.00
10" DN	0	1,335.00	-	-	-
Sub total =	140000		-	3,920.00	3,920.00

2)CONSTRUCTION (50 PSIG NETWORK):

i) Pipeline Laying	Length	Unit Price	Local	Foreign	Total
20" DN x 1000 PSIG	0	3,500.00	0	-	-
14" DN x 300 PSIG	0	2,000.00	0	-	-
12" DN x 50 PSIG	140000	155.79	218.106	-	218.11
10" DN	0	151 82	-	-	-
8" DN	41000	101,66	41 68	-	41.68
6" DN	0	97.32	-	-	-
4" DN	16000	68.26	10 92	-	10.92
3" DN	0	62 07	-	-	-
2" DN	145000	47.30	68.59	-	68 59
1" DN	0	45.47	-	-	-
Sub-Total=	202000		339.29	-	339.29
ii) Pipe Welding	Nos.	Unit Price	Local	Foreign	Total
24" DN Casing Pipe	50	4,000.00	2.00	-	2 00
20" DN x 1000 PSIG	0	3,500.00	-	-	-
14" DN x 300 PSIG	0	2,000 00	-	-	-
12" DN	15517	315 00	48.88	-	48 88
10" DN	0	263.48	-	-	-
8" DN	4545	237.71	10.80	-	10.80
6" DN	0	176.56	-	-	-
4" DN	1774	118.50	2.10	-	2.10
3" DN	0	103.92	-	-	-
2" DN	32142	86.58	27.83	-	27.83
1" DN	0	65.49	-	-	-
		Sub-Total=	91.61	-	91.61

3) OTHERS

iii) Khal, Canal, Culvert Crossing	2500	1,000 00	25.00	-	25 00
iv) Highway Crossing	1000	1,237.00	12 37	-	12.37
v) River Crossing (2 nos.)	0	20,000 00	-		-
v) Valve Pit Construction					-
a) 4"& below	390	13,500.00	52.65	-	52.65
b) above 4"	300	23,000.00	69.00	-	69.00
vi) Road Breaking & Prov. Reinstatement					-
Brick paving	0	68.34	-	-	-
Asphalt paving	342000	49 28	168.54	-	168.54
CC/RCC	0	59.75	-	-	-
			168.54		168.54

4) ROAD RESTORATION

				-	-
Brick Paving	0	618.00	-	-	-
Asphalt Paving	208620	875.00	1,825.43	-	1,825.43
CC/RCC	0	1,003.00	-	-	-
Kutcha	0	65 00	-	-	-
		Sub-Total=	1,825.43	-	1,825.43

Table 6.11 Length of distribution pipeline at Purbachal (Sector 1-10)

Sector	Width(M)	Length (M)	PipeDia	Design length
	9,07	476 52	2	953 04
1	9 14	3886 82	2	7773 64
	11 55	277.37	4	554 74
	12 19	367 56	4	735 12
	12 8	277.37	4	554 74
	16.46	953.42	8	1906.84
	18.29	1287 22	8	2574 44
	22 86	1694 21	12	3388 42
	30 48	416.01	12	832.02
	76.2	1684 41	12	3368 82
	91 44	221.62	12	443 24
2	9,14	5418 43	2	10836 86
	9,75	176.58	2	353 16
	10 97	199 95	2	399 9
	12 19	955.04	4	1910 08
	15 85	499 41	8	998 82
	16,46	955 85	8	1911 7
	22,86	1874 33	12	3748 66
	30,48	569.86	12	1139.72
	45,72	452.78	12	905,56
	76,2	1874 33	12	3748.66
3	9 14	6739 73	2	13479,46
	12 19	1028,97	4	2057.94
	16 46	1719 27	8	3438 54
	22 86	3355.27	12	6710 54
	30 48	369 38	12	738.76
	76 2	2704 49	12	5408 98
4	9,14	3353.26	2	6706 52
	12 19	779 5	4	1559
	16,48	1134 85	8	2269 7
	18 29	1465 66	8	2931 32
	21 85	1206 96	12	2413 92
	22 86	242 19	12	484 38
	30 48	528 8	12	1057 6
5	9 14	8906 62	2	17813 24
	10.18	142,69	2	285,38
	11.58	154 15	4	308 3
	14,9	70 74	8	141 48
	16 46	533 24	8	1066 48
	16 58	332.75	8	665.5
	16 72	16 89	8	33.78
	22 86	1564.31	12	3128.62
	48 77	1049.22	12	2098 44

Sector	Width(M)	Length (M)	PipeDia	Design length
6	9 14	257 38	2	514 76
	22.86	949,11	12	1898 22
	48.77	1024,94	12	2049 88
7	9 14	3998,34	2	7996 68
	9,91	187 42	2	374 84
	12,19	798 23	4	1596.46
	16.46	1210 47	8	2420.94
	19.34	470 52	12	941.04
	22,86	2164 28	12	4328.56
	30,48	479 74	12	959,48
8	9 14	9267 77	2	18535 54
	12,81	234 72	4	469 44
	16 46	785.07	8	1570.14
	22.86	1871 41	12	3742 82
	30 48	1905,03	12	3810,06
9	9 14	8533.72	2	17067 44
	10 07	257.26	2	514 52
	11 89	392 5	4	785
	12,19	376 74	4	753 48
	12 2	205 44	4	410 88
	14 03	256 03	8	512.06
	14,54	482 2	8	964 4
	16 48	571,94	8	1143,88
	17.02	382,83	8	765 66
	22.86	1324 57	12	2649,14
	30,48	946 41	12	1892 82
	98.25	72,54	12	145,08
10	9 14	8271,63	2	16543 26
	9.6	193,08	2	386.16
.	10 06	240 81	2	481.62
	10 08	86.46	2	172.92
	10,72	425 76	2	851.52
	10 97	530 35	2	1060.7
	11 27	394 83	4	789 66
	12,19	378 62	4	757 24
	14	123,44	4	246,88
	16 46	503 33	8	1006 66
	22,86	2221.72	12	4443 44
	30 48	2134.91	12	4269 82
	36 98	558.94	12	1117,88
	45,72	1038.35	12	2076.7

SECTOR: 1-10		
Pipe Dia	Length (M)	Length (Km)
2"	123101 16	123 10116
4"	13488 96	13 48896
8"	26322 34	26,32234
12"	73941,28	73 94128
Total Length	236853,74	236.85374

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Table 6.12 Length of distribution pipeline at Purbachal (Sector 11-20)

Sector	Width (M)	Length (M)	Pipe Dia	Design Length
11	9.14	6449 32	2	12898.64
	12 19	709 4	4	1418.8
	13 43	339 24	4	678 48
	16 46	2499.71	8	4999.42
	17 37	812.79	8	1625 58
	20.12	60 95	12	121.9
	22.86	146 6	12	293 2
	45 72	996 84	12	1993 68
	72 2	956 59	12	1913.18
12	9.14	476 98	2	953 96
	22.86	0	12	0
13	9 14	6549 62	2	13099 24
	11 7	645 99	4	1291 98
	12 19	738 24	4	1476 48
	16 46	1758 34	8	3516 68
	18 67	286 51	8	573 02
	22.86	431.57	12	863.14
	30 48	765 29	12	1530.58
	45.72	510.09	12	1020 18
	91 44	657.89	12	1315 78
14	9 14	2464 66	2	4929 32
	16 46	575 36	8	1150 72
	18 29	1408 57	8	2817 14
	22	400 29	12	800 58
	22.86	1564 1	12	3128 2
15	9 14	3988.75	2	7977 5
	12 04	189 8	4	379 6
	12.19	107.73	4	215 46
	12 35	127 02	4	254 04
	16 46	1141.06	8	2282.12
	22 86	1162 18	12	2324.36
	30.48	902 94	12	1805.88

Sector	Width (M)	Length (M)	Pipe Dia	Design
16	9 14	4408 92	2	8817.84
	9 45	199 95	2	399.9
	11.09	302 42	4	604 84
	12.19	1020.23	4	2040 46
	13 41	371.55	4	743 1
	14 63	220 67	8	441.34
	16 46	357 84	8	715 68
	22 86	1275.07	12	2550.14
	30 48	1426 61	12	2853 22
17	9.14	8510 15	2	17020.3
	16 46	339 85	8	679.7
	22 86	1332 45	12	2664.9
	30.48	316 69	12	633.38
	45 72	0	12	0
18	9.14	6006.67	2	12013.34
	12 17	251.91	4	503.82
	12.19	565 11	4	1130.22
	16 46	884 26	8	1768 52
	22.86	1945 7	12	3891.4
	30 48	1223 22	12	2446 44
	45 72	1055 78	12	2111.56
19	9 23	318.21	2	636 42
	9.78	200 88	2	401.76
	9.83	56 69	2	113 38
	12 11	531.9	4	1063 8
	12 19	7554 72	4	15109 44
	12 2	298.7	4	597.4
	12 27	324 61	4	649.22
	13 94	967.93	4	1935 86
	22.86	4111.47	12	8222.94
	30 48	3269.56	12	6539.12
20	9.14	6254 46	2	12508.92
	10 92	491 15	2	982 3
	12.19	477 42	4	954 84
	16.46	951.28	8	1902 56
	22 86	2911 16	12	5822.32
	30 48	1382 68	12	2765.36
	48 77	936.38	12	1872 76

Sector (11-20)		
Pipe Dia	Length (M)	Length (Km)
2	92752 82	92.75282
4	31047.84	31.04784
8	18952 34	18 95234
12	55555.42	55.55542
Total	198308.42	198.30842

Table 6.13 Length of distribution pipeline at Purbachal (Sector 21-30)

Sector	Width(M)	Length (M)	PipeDia	Design length
21	9.01	60.66	2	121.32
	9.14	8494.75	2	16989.5
	9.87	30.4	2	60.8
	10.97	168.39	2	336.78
	12.19	629.29	4	1258.58
	13.19	39.82	4	79.64
	16.46	2609.22	8	5218.44
	16.87	200.33	8	400.66
	18.29	1827.07	8	3654.14
	22.86	774.61	12	1549.22
	30.48	586.86	12	1173.72
	48.77	1508.16	12	3016.32
22	9.14	8198.30	2	16396.6
	10.97	317.85	2	635.7
	12.19	251.78	4	503.56
	12.8	108.25	4	216.5
	16.46	822.76	8	1645.52
	30.48	2176.97	12	4353.94
	45.72	1027.45	12	2054.9
	48.77	1164.18	12	2328.36
23	9.14	9783.48	2	19566.96
	12.19	717.79	4	1435.58
	13.41	37.21	4	74.42
	16.46	1609.22	8	3218.44
	22.86	972.3	12	1944.6
	30.48	3777.88	12	7555.76
24	9.14	7710.86	2	15421.72
	16.46	3564.97	8	7129.94
	30.48	2210.75	12	4421.5
	45.72	2097.95	12	4195.9
25	9.14	5240.18	2	10480.36
	12.04	1523.44	4	3046.88
	16.46	759.93	8	1519.86
	22.86	1427.37	12	2854.74
	30.48	1893.78	12	3787.56
	45.72	1880.5	12	3761

Sector	Width(M)	Length (M)	PipeDia	Design length
26	9.14	8015.25	2	16030.5
	10.34	355.94	2	711.88
	10.82	181.2	2	362.4
	12.19	563.23	4	1126.46
	16.46	2677.89	8	5355.78
	17.25	353.21	8	706.42
	18.29	1124.11	8	2248.22
	30.48	1853.00	12	3706
	45.72	422.22	12	844.44
27	9.14	7288.45	2	14576.9
	12.19	968.49	4	1936.98
	16.46	458.04	8	916.08
	18.29	511.96	8	1023.92
	22.86	2126.56	12	4253.12
	45.72	2525.2	12	22707
28	9.14	4667.16	2	9334.32
	9.45	125.39	2	250.78
	10.79	254.69	2	509.38
	10.97	368.92	2	737.84
	12.04	254.93	4	509.86
	12.19	1808.52	4	3617.04
	13.02	493.15	4	986.3
	15.42	396.92	8	793.84
	16.46	914.08	8	1828.16
	22.86	1328.82	12	2657.64
	30.48	917.5	12	21225.16
	45.72	2254.16	12	33116
29	9.14	6451	2	12902
	12.19	676.14	4	1352.28
	16.46	1731.52	8	3463.04
	22.86	741.13	12	1482.26
	30.48	917.5	12	1835
	45.72	1143.6	12	2287.2
30	9.14	4793.93	2	9587.86
	16.46	1402.6	8	2805.2
	45.72	403.55	12	807.1
	45.77	1463.51	12	2927.02

Sector (21-30)		
Pipe Dia	Length (M)	Length (Km)
2"	145013.6	145.0136
4"	16144.08	16.14408
8"	41927.66	41.92766
12"	140845.46	140.84546
Total	343930.8	343.9308

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6.4 STATION

Four stations will be built in this project. One of them is City Gate Station (CGS) and three others are Town Border Station (TBS)/ District Regulating Station (DRS). A lump sum costing for stations have been anticipated which is shown in Table 6.1.

6.5 RIVER CROSSING

The Transmission Pipeline will cross the Shitalakhaya River which will be done by Horizontal Directional Drilling (HDD) method. The projected costing of River crossing by HDD method is shown in Table 6.10. The rates of the different components are assumed on the basis of the rates incurred in the recent projects accomplished by the Company.

Table 6.10 Installation of DN 20" pipeline by HDD method (Shitalakhaya River Site)

(b) Length: 600 meters (Approx.)

(c) Design Pressure: 1000 PSIG

SL No.	Description of Item	Quantity	Unit Rate	Foreign Currency (USD)	Local Currency (BDT)
A.0	**Survey, Design and Engineering of HDD.**				
A.1	Detail survey of pipeline route, Hydrographic survey, soil survey etc. and preperation of drawing	Lot	L.S	$ -	157,000.00
A.2	Preperation of Design, Engineering, Bill of Quantity (BOQ) etc.	Lot	L.S.	$ 10,000.00	-
A.3	Preperation of necessary documentation for obtaining of approval from TGTDCL and appropriate concerned agencies.	Lot	L.S	$ -	500,000.00
B.0	**Materials**				
B.1	FBE (Fusion Bonded Epoxy) Coated DN 20" x 0.375" W.T (minimum) API 5L X 60, PSL - 2 Line pipe for River crossing segment	600 Meter	$ 136.68 Tk 5872.19	$ 82,008.00	3,523,314.00
B.2	Heat Shrinkage Sleeve and other consumables for joint coating of DN 20" pipeline	75 Nos	S 150.00	$ 11,250.00	-
B.3	Other materials (Hot Formed bend, Valves, Flanges, Gaskets, B/W fittings, Coating & Wrapping materials etc.)	Lot	L.S	$ 17,636.00	758,000.00
B.4	Hauling and Carrying of material from port to Chittagong port to site	Lot	L.S.	$ -	965,000.00
C.0	**Mobilization**				
C.1	Materials transportation, Site preperation & storage Equipment, Machinaries and Personnel transportation.	Lot	L.S	$ 20,000.00	1,200,000.00
D.0	**Welding and Testing**				
D.1	Welding of Epoxy coated pipe, Radiography (100%), Installation of protective coating (Heat Shrink Sleeves) at welded Joints	75 Nos	2,961.00	$ -	222,075.00
D.2	Radiography (100%)	75 Nos.	5,000.00		375,000.00
D.3	Installation of protective coating (Heat Shrink Sleeves) at welded Joints	75 Nos.	1,000.00		75,000.00
E.0	**Drilling, Reaming, Pulling and Placement of Pipe.**				
E.1	Drilling, reaming, pulling and placement of pipe. The cost includes rent of rig with P.O.L for required days, import fee, transportation of rig, handling of drill pipe, ventonite, cost of ventonite etc and all other required materials not mentioned.The work has to be completed successfully as per Bangladesh Gas & Mineral Safety Rules, approved drawing, design and direction of Engineer - in -	Lot	L.S	$ 284,000.00	3,400,000.00
F.0	**Installation of valves at both ends & Tie-in**				
F.1	Installation of above ground valve at both side of the river (According to indicative drawing) including construction of valve foundation, fabrication etc. complete in all respect as per Bangladesh Gas & Mineral Safety Rules, approved drawing and	Lot	L.S.	$ -	562,000.00
F.2	Tie in of the newly layed pipeline on river bed with existing line at both side of river. The item includes DN 20" pipe laying, welding, pneumatic testing, commissioning etc.	Lot	L.S	$ -	697,000.00
G.0	**Hydrostatic testing of pipeline**				
G.1	Hydrostatic testing, fabrication of temporary pig launcher & receiver, cleaning, gauging, dewatering, drying of pipeline to be installed by HDD method. The Contractor has to supply requisite no. of pigs (Minimum 2 brush,4 cup, 2 foam)	Lot	L.S.	$ -	423,000.00
H.0	**Site Cleanup & Ventonite disposal**				
H.1	Complete Cleaning of site by taking every effort to avoid damage to the environment.	Lot	L.S	$ -	150,000.00
I.0	**Demobilization of Contractor's personnel, equipment etc.**				
I.1	Demobilization of Contractor's personnel, equipment etc.	Lot	L.S	$ 20,000.00	100,000.00
			Sum:	$ 444,894.00	13,107,389.00
			10% Contingency:	$ 44,489.40	1,310,738.90
			Grand Total:	$ 489,383.40	14,418,127.90
	Total (Foreign Currency & Local Currency):				48,234,520.84
			Total (In Lakh Taka):		482.35

CHAPTER-VII

FINANCIAL ANALYSIS

7.1 COMPANY FINANCED PROJECTS (CFP)

In this system full expense of the project is borne by the company which includes material cost, construction cost and other expenses. For financial analysis purpose it is assumed that full load (load applied by customer) will be consumed from the very first year.

7.2 COST SHARING PROJECTS

In this system 80% of the material cost is borne by the Company. And the customer has to bear 20% of total material cost and 100% construction cost and road restoration cost. For financial analysis purposes following assumptions are considered:

a) At the very first year (trial run period) customer will consume 50% of the full load (load applied by customer).

b) At the 2nd year customer will consume 70% of the full load (load applied by customer).

c) From third year (for greater Dhaka and Chittagong area) 8% increase on load consumed of previous year and for other area 5% increase on load consumed of previous year. This growth rate will prevail up to the year it reached to the full load (load applied by customer).

d) The extension of pipeline network will be considered profitable if the Net Pay Back Period is 10 years or less than 10 years.

7.3 SENSITIVITY ANALYSIS

Probable number of customers has been calculated in Table: 7.1 assuming 237878 domestic customers, 1234 commercial customers, 45 Industries, 1 Power station and 594 MW Captive Power consumption by domestic customers. Sensitivity Analysis has been done for various cases which are described in the next pages.

Situation 1:

For this case the project is considered to be fully financed by Company (TGTDCL). The possible numbers of customers of different categories are assumed with the help of following two sources:

Category wise plot allocation data by RAJUK: Revised Purbachal plan, 2005)
No of units & No of flat/plot are calculated as per thumb rule used by Marketing Division Titas Gas T&D Co. Ltd.
In the project plan provided by RAJUK there is provision for three industrial parks. It has been assumed that there will be at least 15 medium scale industries per industrial park.
For captive power consumption only Captive Gas Generator load is considered.
The following assumptions are considered for captive load Calculation:

- For Residential plot Category 3& 4:
  2.7 KW x Customer No considering only light & fan will be connected with generator.
- For Residential Category 5:
  3.2 KW x Customer No considering light, fan & AC will be connected with generator.
- For Residential Category 6:
  4.8 KW x Customer No considering light, fan & AC, oven will be connected with generator.
- For Residential Category 7
  6.5 KW x Customer No considering   light, fan & AC, oven, water heater etc. will be connected with generator.

The appliances are considered on the basis of financial capacity of the owner of the plots of the different category. A power plant of capacity of 10 Mega watts is considering the area and no of people of the proposed new town. The number of customer of different categories assumed considering the above conditions are shown in Table: 7.1.

Table 7.1 No of customer

Residential	No of Plots	Unit	Flat/Plot	No of Domestic Customer	Captive Power (KW)	Total Captive Power (MW)
Category 1 (3 katha)	10078	1	4	40312		**594**
Category 2 (3 Katha)	3575	1	4	14300		
Category 3 (5 Katha)	10875	2	10	108750	293625	
Category 4 (5 Katha)	220	2	10	2200	5940	
Category 5 (7.5 Katha)	2621	3	12	31452	100646.4	
Category 6 (10 Katha)	1997	4	20	39940	191712	
Category 7 (High Rise)	8	4	48	384	2496	
Category 8 (Low Income)	9	4	60	540		
Total no of Domestic customer				**237878**		
Administrative	551					
Commercial	**1234**			**1234**		
Research & Institute	30					
Social Infrastructure(mosque, community centre)	268					
Urban Utility Facilities (Bus station, filling station etc.)	518					
Urban Utility Facilities(Housing blocks)	103					
Physical Infrastructure(School, college etc)	96					
Plaza	119					
Neighborhood play lot	135					
Neighborhood play lot (Housing)	34					
Sports	5					
Industrial Park	**3**		**15**	**45**		
Power Station (10 MW)	**1**			**1**		

Investment cost for the project is estimated in the Chapter VI. As for this situation the project is considered to be fully financed by Company the investment cost for the project is the grand total calculated in the Table 6.1 in Chapter – VI which is also shown in the Table-7.2 of this Chapter. In order to calculate the profit earning from the customers of the different categories the price of the gas is considered as fixed by the Govt. for Distribution Company that is shown in Table 7.3: Distribution Company's Margin.

Table 7.2: Distribution Company's Margin :

Domestic	Tk. 0.740/CM.
Commercial	Tk.1.75/CM.
Industrial	Tk. 0.97/CM.
Captive	Tk. 0.606/CM.
Power station	Tk. 0.24/CM.

To calculate annual value of output average Daily Demand has been considered as per load survey of existing customers and consumption pattern set by the Company.

The following assumptions are made in order to calculate the consumptions by customers of different category:

Consumption Pattern for Domestic Customer :

1046 Cubic Meter gas will be consumed by a Customer per year for a double gas burner.

Consumption Pattern for Commercial Customer:

Small tea stalls, restaurants etc. are considered as the commercial customers. It is assumed that 150 cubic feet gas will be consumed by a commercial customer per hour. The consumption patterns for different category customer are fixed by the Company. Following that pattern total amount of gas consumed by commercial customer is calculated using procedure shown below:

(150 cubic feet per hour x 12hour/day x 30 day/month x12 month/year x 0. 8/35.3147) Cubic Meter/year

0.8 is the diversity factor considered to encounter the fluctuations resulted from pressure and temperature factors. 35.3147 Cubic feet equals one Cubic Meter.

Consumption Pattern for Industrial Customer:

(7500 cubic feet per hour x 12hour/day x 26day/month x12 month/year x 0.8/35.3147) Cubic Meter/year

For a medium scale industry generally 7500 cubic feet gas is required per hour.

Consumption Pattern for Captive Power:

[(Mega watt required x 1000) KW x12 cubic feet x 8 hour/day x 30day/month x 12 month/year x 0.8/35.3147] Cubic Meter/year

As per thumb rule12 Cubic feet gas is needed to Generate 1 KW Power that's why total KW required for captive consumption is multiplied by 12.

Consumption Pattern for Power Station: (10MW x 1000 x12 cubic feet x 24 hours/day x 30 days/month x12 month /year x 0.8/35.3147) Cubic Meter/year

Annual Value of output for this case has been calculated in the column annual output of Table 7.4 by multiplying the consumption for different category customer (as discussed above) and the Distribution Company's margin shown in Table 7.3. Applying total benefit data that is derived from Table 7.4 and investment cost from Table 7.1   NPV, BCR and IRR have been calculated for this case in Table 7.5. Operating cost is considered to be 2.5% of investment cost as per thumb rule. The discount rate is considered as 15% that has been fixed by Government of Bangladesh for this kind of economic analysis. The Rate of Return is shown in the Figure: 7.1.

Table 7.3 Project costing summary (Company Financed)

GROUP- A: Station Construction

Sl.	Component	Quantity		Unit rate	Total amount (in Lakh Taka)
1	CGS (Capacity: 200 MMSCFD)				
a	Material Cost	1	Nos.	150.00	150.00
b	Construction Cost	1	Nos.	30.00	30.00
2	TBS/DRS (Capacity: 50 MMSCFD)				
a	Material Cost	3	Nos.	100.00	300.00
b	Construction Cost	3	Nos.	20.00	60.00
				Total (GROUP A):	540.00

GROUP- B: River Crossing by HDD Method

Sl.	Component	Quantity	Unit rate	Total amount (in Lakh Taka)
1	Shitalakhaya River Crossing			
a	Shitalakhaya river crossing by HDD method (adding 10% contingency)	LOT		482.35
		Total (GROUP B):		482.35

GROUP- C: Pipeline Construction

Sl.	Component	Quantity		Unit rate	Total amount (in Lakh Taka)
1	Transmission Pipeline: (20" x 1000 Psig x 15 km)				
	Distribution Main Pipeline: (14" x 300 Psig x 20 km)				
a	Land Acquistion (Katha), 15 km x 20'	23	acres	10.00	230.00
b	Land Requistion (Katha), 15 km x 30'	35	acres	3.00	105.00
c	Road Restoration Charge	12200	sqm.		186.81
d	Material Cost		LOT		4,582.39
e	Construction Cost	35000	M		1,396.48
f	Other Cost		L.S.		15.00
				Sub-Total (C.1):	6,515.68
2	Feeder Main Pipeline: (12" x 50 Psig x 274km)				
	Distribution Pipeline: (8" x 50 Psig x 90 km)				
	Distribution Pipeline: (4" x 50 Psig x 62 km)				
	Distribution Pipeline: (2" x 50 Psig x 360 km)				
a	Road Restoration Charge	479460	sqm.		4,125.89
b	Material Cost		LOT		28,909.34
c	Construction Cost	50000	m	320.00	1,682.15
				Sub-Total (C.2):	34,717.38
				Total (GROUP - C).	41,233.06
				Total (A+B+C):	42,255.41
				4% Contingency (excluding Group B)	1,670.92
				Grand Total:	43,926.33

Table 7.4 Annual value of output (Situation 1)

YEAR	No. of Customers					Consumption (CM)						Annual out put					Total Benefit
	Ind.	Power Station	Captive	Com.	Dom.	Ind.	Power Station	Captive	Com.	Dom	Total	Ind.	Power Station	Cap.	Com.	Dom.	(lakh taka)
2008-09																	
2	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
3	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
4	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
5	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
6	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
7	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
8	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
9	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
10	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
11	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
12	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
13	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
14	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
15	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
16	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
17	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
18	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
19	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
20	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85
21	45	1	1	1,234	237,878	28,624,906.91	23,487,103.10	935,569,606.99	18,114,428.27	248,820,388.00	1,254,616,433.27	277.66	56.37	5,669.55	317.00	1,841.27	8,161.85

Note:
Average Daily Demand has been considered as per load survey of existing & probable Customers.
12 Cft gas is needed to Generate 1 KW Power

Assumption :
Consumption Pattern for Domestic Customer : 1046 CM/Customer/Yr
Consumption Pattern for Commercial Customer :(150 cft/hr x 12hr/day x 30day/month x12 month/yr x 0.8/35.3147)CM/yr
Consumption Pattern for Industrial Customers(7300 cft/hr x 12hr/day x 26day/month x12 month/yr x 0.8/35.3147)CM/yr
Consumption Pattern for Captive Power:(MW x 1000 x12 cft x 8 hr/day x 30day/month x12 month/yr x 0.8/35.3147)CM/yr
Consumption Pattern for Power Station: (10MW x 1000 x12 cft x 24 hr/day x 30day/month x12 month/yr x 0.8/35.3147)CM/yr

Table 7.5 Financial analysis of BCR , NPV & IRR. (Situation 1)

(In Lakh Taka)

YEAR		Investment Cost	Operating Cost(2.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	1	43,926.33	-	43,926.33		(43,926.33)	1.000000	43,926.330	-	-43,926.33	43,926.33
	2	-	1,098.16	1,098.16	8,161.85	7,063.69	0.869565	954.922	7,097.26	6,142.34	(37,783.99)
	3	-	1,098.16	1,098.16	8,161.85	7,063.69	0.756144	830.367	6,171.53	5,341.17	(32,442.82)
	4	-	1,098.16	1,098.16	8,161.85	7,063.69	0.657516	722.058	5,366.55	4,644.49	(27,798.33)
	5	-	1,098.16	1,098.16	8,161.85	7,063.69	0.571753	627.876	4,666.56	4,038.69	(23,759.64)
	6	-	1,098.16	1,098.16	8,161.85	7,063.69	0.497177	545.980	4,057.88	3,511.90	(20,247.74)
	7	-	1,098.16	1,098.16	8,161.85	7,063.69	0.432328	474.765	3,528.60	3,053.83	(17,193.91)
	8	-	1,098.16	1,098.16	8,161.85	7,063.69	0.375937	412.839	3,068.34	2,655.50	(14,538.41)
	9	-	1,098.16	1,098.16	8,161.85	7,063.69	0.326902	358.991	2,668.13	2,309.13	(12,229.28)
	10	-	1,098.16	1,098.16	8,161.85	7,063.69	0.284262	312.165	2,320.10	2,007.94	(10,221.34)
	11	-	1,098.16	1,098.16	8,161.85	7,063.69	0.247185	271.449	2,017.49	1,746.04	(8,475.30)
	12	-	1,098.16	1,098.16	8,161.85	7,063.69	0.214943	236.042	1,754.33	1,518.29	(6,957.01)
	13	-	1,098.16	1,098.16	8,161.85	7,063.69	0.186907	205.254	1,525.51	1,320.25	(5,636.76)
	14	-	1,098.16	1,098.16	8,161.85	7,063.69	0.162528	178.482	1,326.53	1,148.05	(4,488.71)
	15	-	1,098.16	1,098.16	8,161.85	7,063.69	0.141329	155.202	1,153.51	998.30	(3,490.41)
	16	-	1,098.16	1,098.16	8,161.85	7,063.69	0.122894	134.957	1,003.04	868.09	(2,622.32)
	17	-	1,098.16	1,098.16	8,161.85	7,063.69	0.106865	117.355	872.22	754.86	(1,867.46)
	18	-	1,098.16	1,098.16	8,161.85	7,063.69	0.092926	102.048	758.45	656.40	(1,211.06)
	19	-	1,098.16	1,098.16	8,161.85	7,063.69	0.080805	88.737	659.52	570.78	(640.28)
	20	-	1,098.16	1,098.16	8,161.85	7,063.69	0.070265	77.162	573.49	496.33	(143.95)
	21	-	1,098.16	1,098.16	8,161.85	7,063.69	0.061100	67.098	498.69	431.59	287.64
								50,800.09	51,087.73		

BCR (F):	1.01	
NPV @15%:	287.65	LAKH TAKA
IRR:	14.94%	
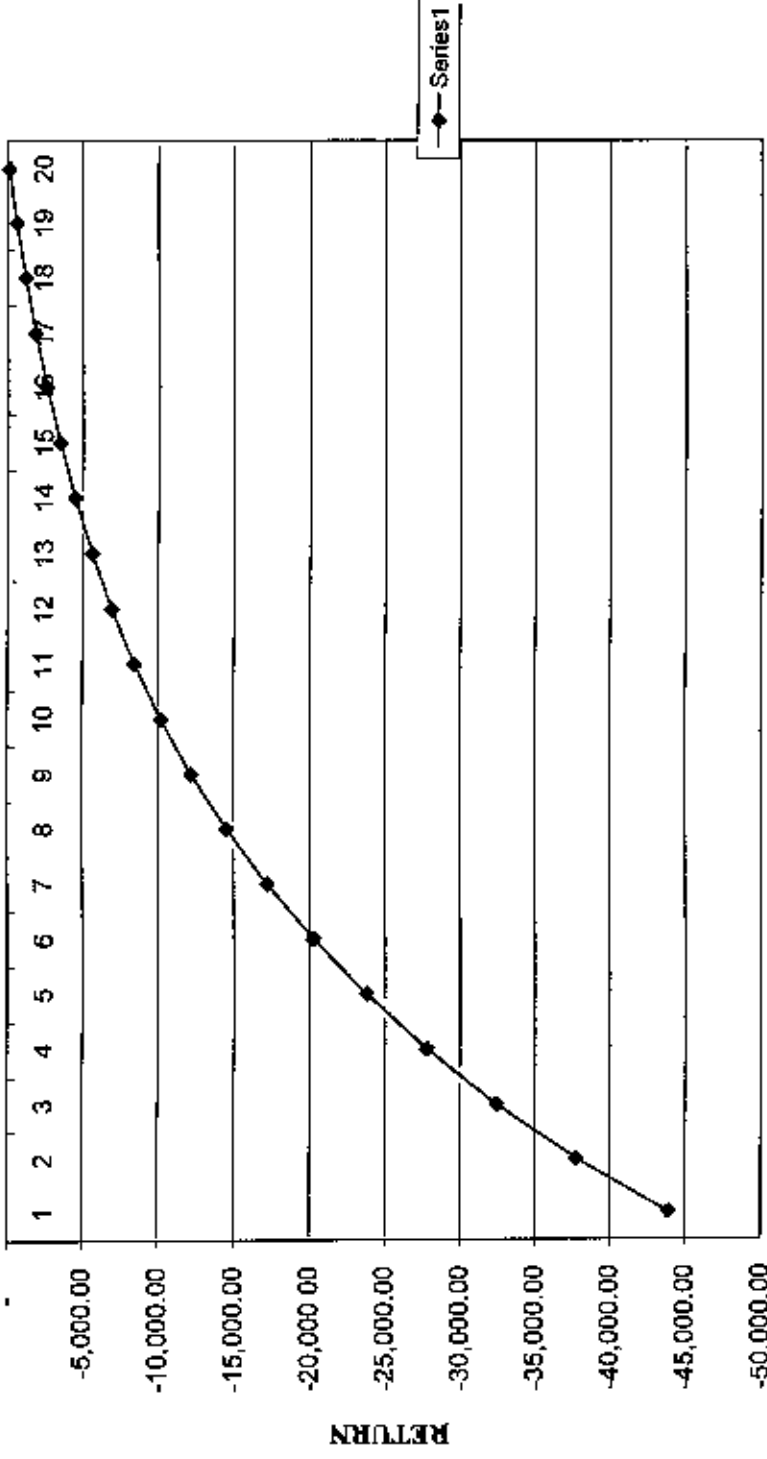
Figure 7.1 : RATE OF RETURN (Situation 1)

The financial analysis for Situation 1 results in following conclusion:

NPV	=	287.65 Lakh Taka
BCR	=	1.01
IRR	=	14.94%
Pay Back Period	=	Over 20 Years

For this case, NPV > 0 and Benefit Cost Ratio that is benefit per taka cost is slightly greater than 1 which indicates that the project is marginally profitable. But Internal Rate of Return for this case is below 15% and the Pay Back Period is over 20 years which is not acceptable.

Situation 2:

For this case the cost of the project is considered to be shared by RAJUK and TGTDCL, which means that 80% of the material cost will be born by TGTDCL and 20% of the material cost will be borne by RAJUK. Investment cost for TGTDCL for Cost Sharing Project is shown in Table 7.6. The annual value of output calculation is based on the primary assumption on probable number of customer calculated in Table: 7.1. Annual Value of output has been calculated according to the rules of cost sharing project. Following are the rules for load calculation for cost sharing project.

a. At the very first year (trial run period) customer will consume 50% of the full load (load applied by customer).

b. At the 2nd year customer will consume 70% of the full load (load applied by customer).

c. From third year (for greater Dhaka and Chittagong area) 8% increase on load consumed of previous year and for other area 5% increase on load consumed of previous year. This growth rate will prevail up to the year it reached to the full load (load applied by customer).

d. The extension of pipeline network will be considered profitable if the Net Pay Back Period is 10 years or less than 10 years.

Applying the above conditions probable load consumption has been calculated in the Table 7.7. Total benefit has been calculated by multiplying the possible consumption with Distribution Company's Margin which is shown in Table 7.3. Applying total benefit data that is derived from Table 7.7 financial analysis for NPV, BCR and IRR is done in Table 7.8. Operating cost is considered to be 2.5% of investment cost as per thumb rule. The discount rate is considered as 15% that has been fixed by Government of Bangladesh for this kind of economic analysis. The Rate of Return is shown in the Figure: 7.2.

Table7.6: Investment cost for cost sharing project

GROUP- A: Station Construction

Sl. No.	Component	Quantity		Unit rate	Total amount (in Lakh taka)
1	CGS (Capacity: 200 MMSCFD)				
a	Material Cost	1	Nos.	150.00	150.00
2	TBS/DRS (Capacity: 50 MMSCFD)				
a	Material Cost	3	Nos.	100.00	300.00
				Total (GROUP A):	450.00

GROUP- B: River Crossing by HDD Method

Sl. No.	Component	Quantity		Unit rate	Total amount (in Lakh taka)
1	Shitalakhaya River Crossing				
a	Shitalakhaya river crossing by HDD method (adding 10% contingency)		LOT		482.35
				Total (GROUP B):	482.35

GROUP- C: Pipeline Construction

Sl. No.	Component	Quantity		Unit rate	Total amount (in Lakh taka)
1	Transmission Pipeline: (20" x 1000 Psig x 15 km)				
	Distribution Main Pipeline: (14" x 300 Psig x 20 km)				
a	Land Acquistion (Katha), 15 km x 20'	23	acres	10.00	230.00
b	Land Requistion (Katha), 15 km x 30'	35	acres	3.00	105.00
c	Road Restoration Charge	12200	sqm.		186.81
d	Material Cost		LOT		4,582.39
				Sub-Total (C.1):	5,104.20
2	Feeder Main Pipeline: (12" x 50 Psig x 274km)				
	Distribution Pipeline: (8" x 50 Psig x 90 km)				
	Distribution Pipeline: (4" x 50 Psig x 62 km)				
	Distribution Pipeline: (2" x 50 Psig x 360 km)				
a	Material Cost		LOT		28,909.34
				Sub-Total (C.2):	28,909.34
				Total (GROUP - C):	34,013.54
				Total (A+B+C):	34,945.89
				4% Contingency (excluding Group B)	1,378.54
				Grand Total:	36,324.43
				80% of Grand Total:	29,059.54

Table 7.7: Annual value of output (Situation 2)

Year	No. of Customers				Consumption (CM)					Annual Value of Output						Total Benefit (lakh rs/yr)
	Ind.	Power Station	Captive	Com.	Dom.	Power Station	Ind.	Captive	Com.	Dom.	Total	Ind.	Power Station	Cap.	Com.	Dom.	
2005-06																	
2	45	1	1	1,234	235,012	11,743,331.55	14,312,433.43	467,734,001.38	9,837,314.13	121,843,276.00	614,763,298.63	134.83	24.13	3,034.73	135.98	931.88	4,062.09
3	45	1	1	1,234	235,012	16,446,972.17	20,093,434.84	454,598,721.89	12,646,099.79	190,611,346.48	158,237,643.92	194.34	39.44	3,968.64	221.90	1,262.53	3,686.93
4	45	1	1	1,234	235,012	17,796,249.94	21,668,429.63	787,270,621.83	13,994,587.77	114,260,297.31	956,883,337.99	209.91	42.63	4,236.11	234.61	1,363.35	6,141.88
5	45	1	1	1,234	235,012	19,176,749.94	23,371,644.00	763,373,672.71	14,790,004.39	199,001,121.09	1,091,036,726.19	226.71	46.83	4,629.66	253.83	1,472.61	6,633.23
6	45	1	3	1,234	235,012	20,210,389.94	23,241,397.12	624,903,712.53	15,973,273.88	214,921,218.74	1,091,119,664.29	244.84	49.91	4,999.40	275.33	1,599.42	7,163.99
7	45	1	1	1,234	235,012	22,367,701.14	27,360,700.89	590,982,413.13	17,231,135.77	231,114,907.64	1,167,409,237.43	264.43	53.48	5,399.35	301.97	1,717.65	7,737.09
8	45	1	1	1,234	235,012	23,447,103.80	28,634,906.91	935,369,606.99	18,114,428.27	243,738,352.00	1,226,079,494.37	277.66	56.37	5,669.55	317.00	1,803.61	8,124.19
9	45	1	1	1,234	235,012	23,447,103.80	28,634,906.91	935,369,606.99	18,114,428.27	243,738,352.00	1,226,079,494.17	277.66	56.37	5,669.55	317.00	1,803.61	8,124.19
10	45	1	1	1,234	235,012	23,447,103.10	28,634,906.91	935,369,606.99	18,114,428.27	243,738,352.00	1,226,079,494.17	277.66	56.37	5,669.55	317.00	1,803.61	8,124.19
11	45	1	2	1,234	235,012	23,447,103.10	28,634,906.91	935,369,606.99	18,114,428.27	243,738,352.00	1,226,079,494.17	277.66	56.37	5,669.55	317.00	1,803.61	8,124.19
12	45	1	1	1,234	235,012	23,447,103.10	28,634,906.91	935,369,606.99	18,114,428.27	243,738,352.00	1,226,079,494.17	277.66	56.37	5,669.55	317.00	1,803.61	8,124.19
13	45	1	1	1,234	235,012	23,447,103.10	28,634,906.91	935,369,606.99	18,114,428.27	243,738,352.00	1,226,079,494.17	277.66	56.37	5,669.55	317.00	1,803.61	8,124.19
14	45	1	1	1,234	235,012	23,447,103.10	28,634,906.91	935,369,606.99	18,114,428.27	243,738,352.00	1,226,079,494.17	277.66	56.37	5,669.55	317.00	1,803.61	8,124.19
15	45	1	1	1,234	235,012	23,447,103.10	28,634,906.91	935,369,606.99	18,114,428.27	243,738,352.00	1,226,079,494.17	277.66	56.37	5,669.55	317.00	1,803.61	8,124.19
16	45	1	1	1,234	235,012	23,447,895.18	28,634,906.91	935,369,606.99	18,114,428.27	243,738,352.00	1,226,079,494.13	277.66	56.37	5,669.55	317.00	1,803.61	8,124.19
17	45	1	1	1,234	235,012	23,447,895.18	28,634,906.91	935,369,606.99	18,114,437.27	243,738,352.00	1,226,079,494.17	277.66	56.37	5,669.55	317.00	1,803.61	8,124.19
18	45	1	1	1,234	235,012	23,447,103.18	28,634,906.91	935,369,606.99	18,114,437.27	243,738,352.00	1,226,079,494.13	277.66	56.37	5,669.55	317.00	1,803.61	8,124.19
19	45	1	1	1,234	235,012	23,447,103.18	28,634,906.91	935,369,606.99	18,114,478.27	243,738,352.00	1,226,079,494.17	277.66	56.37	5,669.55	317.00	1,803.61	8,124.19
20	45	1	1	1,234	235,012	23,447,103.18	28,634,906.91	935,369,606.99	18,114,478.27	243,738,352.00	1,226,079,494.17	277.66	56.37	5,669.55	317.00	1,803.61	8,124.19
21	45	1	1	1,234	235,012	23,447,103.18	28,634,906.91	935,369,606.99	18,114,428.27	243,738,352.00	1,226,079,494.17	277.66	56.37	5,669.55	317.00	1,803.61	8,124.19

Note:
Average Daily Demand has been considered as per load survey of existing & probable Customers.
12 Cft gas is needed to Generate 1 KW Power

Assumption :
Consumption Pattern for Domestic Customer : 1046 CM/Customer/Yr
Consumption Pattern for Commercial Customer : (150 cft/hr x 12hr/day x 30day/month x 12 month/yr x 0.8/35.3147) CM/yr
Consumption Pattern for Industrial Customer : (7300 cft/hr x 12hr/day x 26day/month x 12 month/yr x 0.8/35.3147) CM/yr
Consumption Pattern for Captive Power : (MW x 1000 x 12 cft x 8 hr/day x 30day/month x 12 month/yr x 0.8/35.3147) CM/yr
Consumption Pattern for Power Station : (10 MW x 1000 x 12 cft x 24 hr/day x 30day/month x 12 month/yr x 0.8/35.3147) CM/yr

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Table 7.8: Financial analysis of BCR, NPV & IRR (Situation 2)

(In Lakh Taka)

YEAR		Investment Cost	Operating Cost(2.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	1	29,059.54	-	29,059.54	-	(29,059.54)	1.000000	29,059.540	-	-29,059.54	-29,059.54
	2	-	726.49	726.49	4,062.09	3,335.60	0.869565	631.730	3,532.25	2,900.52	(26,159.02)
	3	-	726.49	726.49	5,686.93	4,960.44	0.756144	549.331	4,300.14	3,750.81	(22,408.21)
	4	-	726.49	726.49	6,141.88	5,415.39	0.657516	477.679	4,038.38	3,560.71	(18,847.50)
	5	-	726.49	726.49	6,633.25	5,906.76	0.571753	415.373	3,792.58	3,377.21	(15,470.29)
	6	-	726.49	726.49	7,163.90	6,437.41	0.497177	361.194	3,561.73	3,200.53	(12,269.76)
	7	-	726.49	726.49	7,737.00	7,010.51	0.432328	314.082	3,344.92	3,030.84	(9,238.92)
	8	-	726.49	726.49	8,124.19	7,397.70	0.375937	273.114	3,054.18	2,781.07	(6,457.85)
	9	-	726.49	726.49	8,124.19	7,397.70	0.326902	237.491	2,655.81	2,418.32	(4,039.53)
	10	-	726.49	726.49	8,124.19	7,397.70	0.284262	206.514	2,309.40	2,102.88	(1,936.65)
	11	-	726.49	726.49	8,124.19	7,397.70	0.247185	179.577	2,008.18	1,828.60	(108.05)
	12	-	726.49	726.49	8,124.19	7,397.70	0.214943	156.154	1,746.24	1,590.08	1,482.03
	13	-	726.49	726.49	8,124.19	7,397.70	0.186907	135.786	1,518.47	1,382.68	2,864.71
	14	-	726.49	726.49	8,124.19	7,397.70	0.162528	118.075	1,320.41	1,202.33	4,067.04
	15	-	726.49	726.49	8,124.19	7,397.70	0.141329	102.674	1,148.18	1,045.51	5,112.55
	16	-	726.49	726.49	8,124.19	7,397.70	0.122894	89.281	998.41	909.13	6,021.68
	17	-	726.49	726.49	8,124.19	7,397.70	0.106865	77.636	868.19	790.56	6,812.24
	18	-	726.49	726.49	8,124.19	7,397.70	0.092926	67.510	754.95	687.44	7,499.68
	19	-	726.49	726.49	8,124.19	7,397.70	0.080805	58.704	656.48	597.77	8,097.45
	20	-	726.49	726.49	8,124.19	7,397.70	0.070265	51.047	570.85	519.80	8,617.25
	21	-	726.49	726.49	8,124.19	7,397.70	0.061100	44.389	496.39	452.00	9,069.25
								33,606.88	42,676.14		

BCR (F) :	1.27	
NPV @15% :	9069.26	LAKH TAKA
IRR :	19.54%	

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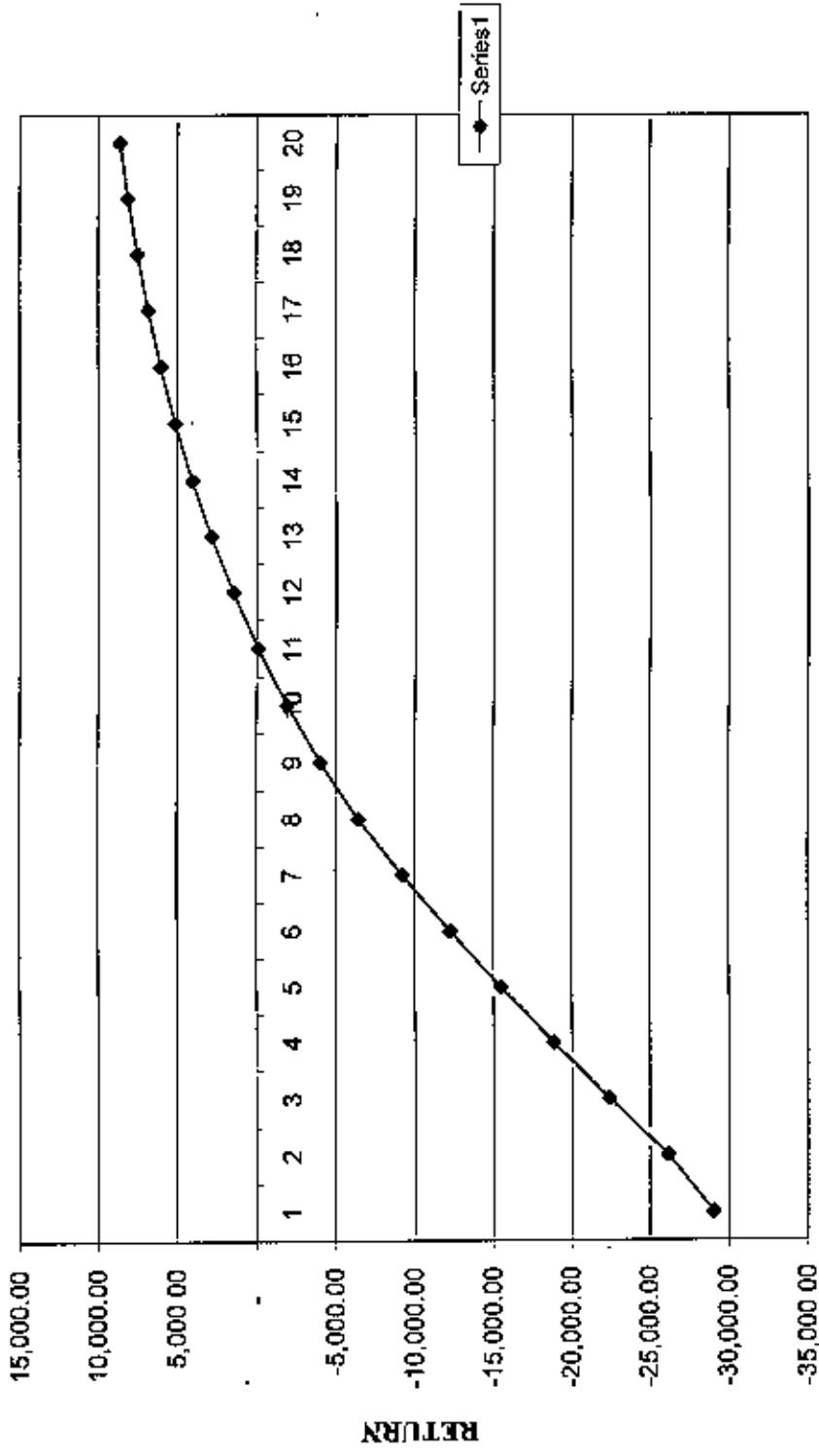
YEAR

Figure 7.2: RATE OF RETURN (Situation 2)

The financial analysis for situation 2 results in following conclusion:

NPV	=	9096.26 Lakh Taka
BCR	=	1.27
IRR	=	19.54%
Pay Back Period	=	12 Years (Appx.)

For this case, NPV > 0 and Benefit Cost Ratio that is benefit per taka cost is greater than 1 which indicates that the project is profitable. Internal Rate of Return for this case is over 15% and the Pay Back Period is 12 years. Moreover NPV is much higher than case 1. So this case is a better option.

Similar analysis has been done for 14 other situations which are as follows:

1. For Company financed project 5% decrease in consumption of gas volume from the primary assumption on probable number of customer (Table 7.1). Annual value of output calculation, financial analysis for NPV, BCR and IRR and Rate of return for this situation is shown in Appendix A.

2. For Company financed project 5% increase in consumption of gas volume from the primary assumption on probable number of customer. Annual value of output calculation, financial analysis for NPV, BCR and IRR and Rate of return for this situation is shown in Appendix B.

3. For Company financed project 5% increase on the present rate of gas for customer of various categories. Annual value of output calculation, financial analysis for NPV, BCR and IRR and Rate of return for this situation is shown in Appendix C.

4. For Company financed project 10% increase on the present rate of gas for customer of various categories. Annual value of output calculation, financial analysis for NPV, BCR and IRR and Rate of return for this situation is shown in Appendix D.

5. For Company financed project 20% increase on the present rate of gas for customer of various categories. Annual value of output calculation, financial analysis for NPV, BCR and IRR and Rate of return for this situation is shown in Appendix E.

6. For Company financed project 25% increase on the present rate of gas for customer of various categories. Annual value of output calculation, financial analysis for NPV, BCR and IRR and Rate of return is shown in Appendix F.

7. For Company financed project 30% increase on the present rate of gas for customer of various categories. Annual value of output calculation, financial analysis for NPV, BCR and IRR and Rate of return is shown in Appendix G.

8. For cost sharing project 5% decrease in consumption of gas volume from the primary assumption on probable number of customer (Table 7.1). Annual value of output calculation, financial analysis for NPV, BCR and IRR and Rate of return is shown in Appendix H.

9. For cost sharing project 5% increase in consumption of gas volume from the primary assumption on probable number of customer (Table 7.1). Annual value of output calculation, financial analysis for NPV, BCR and IRR and Rate of return is shown in Appendix H.

10. For cost sharing project 5% increase on the present rate of gas for customer of various categories. Annual value of output calculation, financial analysis for NPV, BCR and IRR and Rate of return is shown in Appendix I.

11. For cost sharing project 10% increase on the present rate of gas for customer of various categories. Annual value of output calculation, financial analysis for NPV, BCR and IRR and Rate of return is shown in Appendix J.

12. For cost sharing project 20% increase on the present rate of gas for customer of various categories. Annual value of output calculation, financial analysis for NPV, BCR and IRR and Rate of return is shown in Appendix L.

13. For cost sharing project 25% increase on the present rate of gas for customer of various categories. Annual value of output calculation, financial analysis for NPV, BCR and IRR and Rate of return for this situation is shown in Appendix M.

14. For cost sharing project 30% increase on the present rate of gas for customer of various categories. Annual value of output calculation, financial analysis for NPV, BCR and IRR and Rate of return for this situation is shown in Appendix N.

CHAPTER –VIII

CRITICAL PATH SCHEDULING

8.1 PROJECT MANAGEMENT

A project may be defined as a series of related jobs usually directed toward some major output and requiring a significant period of time to perform. Project management can be defined as planning, directing, and controlling resources (people, equipment, and material) to meet the technical, cost and time constraints of the project.

A project starts out as a statement of work (SOW). The SOW may be written description of the objectives to be achieved, with a brief statement of the work to be done and a proposed schedule specifying the start and completion dates. It could also contain performance measures in terms of budget and completion steps (milestones) and the written reports to be supplied.

A task is a further subdivision of a project. It is usually not longer than several months in duration and is performed by one group or organization. A subtask may be used if needed to further subdivide the project into more meaningful pieces.

8.2 CRITICAL PATH SCHEDULING

Critical path scheduling refers to a set of graphic techniques used in planning and controlling projects. In any project, the three factors of concern are time, cost and resource availability. Critical path techniques have been developed to deal with each of these, individually and in combination.

PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method), the two best known critical path scheduling techniques, were both developed in the late 1950s. PERT was developed under the sponsorship of the U.S. Navy Special Projects office in 1958 as a management tool for scheduling and controlling the Polaris missile project. CPM

was developed in 1957 by J.E. Kelly of Remington-Rand and M.R. Walker of Du Pont to aid in scheduling maintenance shutdowns of chemical process plants.

Critical Path scheduling techniques display a project in graphic form and relate its component tasks in a way that focuses attention on those crucial to the project's completion. For critical path scheduling techniques to be most applicable, a project must have the following three characteristics:

a) It must have well-defined jobs or tasks whose completion marks the end of the project.

b) The jobs or tasks are independent; they may be started, stopped and conducted separately within a given sequence.

c) The jobs or tasks are ordered; they must follow each other in a given sequence.

The basic forms of PERT and CPM focus on finding the longest time-consuming path through a network of tasks as a basis for planning and controlling a project. Both PERT and CPM use nodes and arrows for display. Originally, the basic differences between PERT and CPM was that PERT used the arrow to represent an activity and CPM used the node. The other original difference was that PERT used three estimates -- optimistic, pessimistic and best-of an activity's required time, whereas CPM used just the best estimate. This distinction reflects PERT's origin in scheduling advanced projects that are characterized by uncertainty and CPM's origin in the scheduling of the fairly routine activity of plant maintenance. As years past passed, these two features no longer distinguished PERT from CPM. This is because CPM users started to use three time estimates and PERT users often placed activities on the nodes.

We believe the activity on the node is much easier to follow logically than the activity on the arrow. The three time estimates are used to measure the probability, the probability of completion times. Therefore, in this chapter we use the activity on the node and either a single estimate for activity time or three time estimates, depending on our objective.

In a sense, both techniques owe their development to their widely used predecessor, the Gantt Chart. While the Gantt Charts able to relate activities to time in a usable fashion for very small projects, the interrelationship of activities, when displayed in this form , becomes extreme difficult to visualize and to work with for projects with more than 25 or

30 activities. Also, the Gantt chart provides no direct procedure for determining the critical path, which despite its theoretical shortcomings, is of great practical value.

8.3 GANTT CHART

A Gantt chart is a bar chart showing both the amount of time involved and the sequence in which activities can be performed. The independent activities can be done simultaneously. All other activities must be done in the sequence from top to bottom.

8.4 PURBACHAL PROJECT GANTT CHART

A Gantt chart of Purbachal project has been constructed showing both the amount of time involved and the sequence in which these activities can be performed. The Purbachal Project includes the following tasks:

1. Preparation of tender document (tender for survey and preparation of detail drawings) evaluation, awarding of contract and completion of works.
2. Preparation of tender document (tender for IEE), evaluation, awarding of contract and completion of works. Task 1 is the predecessor of task 2.
3. Submission of Acquisition & Reqnisition proposal to the concerned authority, taking over possession of lands. Task 1 & 2 is the predecessor of task 3.
4. Preliminary Detail Design, Preparation of material list & estimation. Task 1 is the predecessor of task 4.
5. Preparation of tender document for material procurement, Tender floating, evaluation, award of contract and delivery of materials (Foreign & Local materials). Task 4 is the predecessor of task 5.
6. Preparation of tender document for River crossing by HDD method, tender floating,
. evaluation, awarding of contract and completion of river crossing by HDD. Task 3,4 & 5 is the predecessor of task 6.
7. Preparation of tender document for construction of transmission pipeline, tender floating, evaluation, award of contract and construction of transmission pipe line. Task 4 is the predecessor of task 7.

8. Preparation of tender document for construction of distribution pipeline, tender floating, evaluation, award of contract and construction of distribution pipe line. Task 3 is the predecessor of task 8.

9. Preparation of tender document for construction of CP works, tender floating, evaluation, award of contract and construction of CP. Task 6, 7 & 8 is the predecessor of task 9.

10. Preparation of tender document for construction of civil works, tender floating, evaluation, award of contract and completion of civil work construction. Task 7 & 8 is the predecessor of task 10.

11. Preparation of tender document for construction of M&R station, tender floating, evaluation, award of contract and construction / installation of M&R stations. Task 3 & 4 is the predecessor of task 11.

12. Commissioning of Pipe line & Stations. Task 8, 9, 10 & 11 is the predecessor of task 12.

8.5   PURBACHAL NETWORK DIAGRAM

A network diagram has been constructed showing the critical path is shown. From network diagram it is apparent that 1-2-3-8-10-12 is the critical path.

Table 8.1 Extension of gas pipeline at Purbachal (Gantt chart)

ID	Task Name	Duration	Start
1	Preparation of tender document (tender for survey and preparation of detail drawings) evaluation, awarding of contract and completion of works	20 wks	Tue 7/1/08
2	Preparation of tender document (tender for IEE) evaluation, awarding of contract and completion of works	18 wks	Tue 11/18/08
3	Submission of Acquisition & Requisition proposal, taking over possession of lands	60 wks	Tue 3/24/09
4	Preliminary Detail Design, Preparation of material list & estimation	3 wks	Tue 11/18/08
5	Preparation of tender document for material procurement, Tender floating, evaluation, awarding of contract and delivery of materials (Foreign & Local materials)	50 wks	Tue 12/9/08
6	Preparation of tender document for HDD work, Tender floating, evaluation, awarding of contract and completion of river crossing by HDD	35 wks	Tue 5/18/10
7	Preparation of tender document for construction of distribution pipeline, tender floating, evaluation, awarding of contract and construction of distribution pipe line	30 wks	Tue 12/9/08
8	Preparation of tender document for construction of transmission pipeline, tender floating, evaluation, awarding of contract and construction of transmission pipe line	20 wks	Tue 5/18/10
9	Preparation of tender document for construction of CP works, tender floating, evaluation, awarding of contract and construction of CP	22 wks	Tue 1/18/11
10	Preparation of tender document for construction of civil works, tender floating, evaluation, awarding of contract and completion of civil work construction,	40 wks	Tue 10/5/10
11	Preparation of tender document for construction of M&R station, tender floating, evaluation, awarding of contract and construction / installation of M&R stations,	28 wks	Tue 5/18/10
12	Commissioning of Pipe line & Stations	4 wks	Tue 7/12/11

Project: Purbachal New town Gas Distribution Project
Date: Wed 11/12008

Task	Milestone	Rolled Up Critical Task	Group By Summary
Critical Task	Summary	Rolled Up Milestone	Deadline
Progress	Rolled Up Task	Rolled Up Progress	
	Split	External Tasks	
		Project Summary	

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Finished

COMPLETION TIME 162 WEEKS

TOTAL SLACK = 156

CRITICAL PATH · 1-2-3-6-10-12

ES = 118 EF = 158
LS = 118 LF = 158
Slack = 0

10
40 W

ES = 158 EF = 162
LS = 158 LF = 162
Slack = 0

12
4 W

ES = 133 EF = 155
LS = 136 LF = 158
Slack = 3

9
22 W

ES = 98 EF = 118
LS = 98 LF = 118
Slack = 0

8
20 W

ES = 23 EF = 53
LS = 88 LF = 118
Slack = 65

7
30 W

FS = 98 EF = 133
LS = 101 LF = 136
Slack = 3

6
35 W

FS = 98 EF = 126
LS = 130 LF = 158
Slack = 32

11
28 W

ES = 23 EF = 73
LS = 51 LF = 101
Slack = 28

5
50 W

ES = 20 EF = 23
LS = 48 LF = 51
Slack = 28

4
3 W

FS = 98 EF = 98
LS = 38 LF = 98
Slack = 0

3
60 W

ES = 0 EF = 20
LS = 0 LF = 20
Slack = 0

1
20 W

ES = 20 EF = 38
LS = 20 LF = 38
Slack = 0

2
18 W

Figure 8.1: Critical path scheduling

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CHAPTER – IX

CONCLUSIONS AND RECOMMENDATIONS

9.1 CONCLUSIONS

Financial analysis has been done for two different situations: i) for company financed projects and ii) for cost sharing projects. Different technical evaluation such as NPV, BCR, IRR and EIA etc. are formulated to analyze the profitability and feasibility of the project. The findings are:

a) The total cost of project is 43926.33 lakh taka and total gas demand in next 20 years at Purbachal Project area would be 1254 MMCMD.

b) If the project is Company Financed the NPV is 287.65 Lakh Taka, IRR is around 15% and BCR of 1.01 indicate that the project is feasible. Net Pay Back Period is over 20 years if the project is financed by Company.

c) If the project is done by Cost Sharing, the NPV is 9096.26, IRR is around 19.54% and BCR is 1.27 which also indicates that the project is feasible. Net Pay Back Period is 12 years. This case is a better option over case 1.

d) If the project is Company Financed and the gas price is increased by 30% over the present rate, the NPV is 13484.80 IRR is around 20.17% and BCR is 1.27 which also indicates that the project is feasible. Net Pay Back Period is 11 years. Although BCR is same for both cases but NPV for this case is higher than case 2.

e) If the project is done by Cost Sharing and the gas price is increased by 30% over the present rate, the NPV is 20812.44, IRR is 24.96%, BCR is 1.62 and Net Pay Back Period is 8 years. This case shows the best result.

f) Implementation of the project will create investment opportunities for setting up new industries specially garments, textile, Electronic, Computer based industries to this area because of the proximity of the capital city.

9.2 RECOMMENDATIONS

a) Skillful and effective maintenance and monitoring system should be adapted to provide smooth network operation.

b) To cope up with the growing demand for housing sustainable expansion of the Dhaka city is essential. The planning authority of the city bears the responsibility to device an optimum equilibrium design for the city considering the demand for development and long term sustainability of urban areas.

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APPENDIX

Table A-1 Annual value of output

YEAR	No. of Customers					Consumption (CM)						Annual Value of output					Total Benefit
	Ind.	Power Station	Captive	Cert.	Dom.	Ind.	Power Station	Captive	Com.	Dom.	Total	Ind.	Power Station	Cap.	Com.	Dem.	(lakh taka)
2008-09																	
2	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
3	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
4	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
5	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
6	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
7	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
8	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
9	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
10	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
11	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
12	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
13	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
14	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
15	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
16	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
17	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
18	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
19	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	101.15	1,749.21	7,753.76
20	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76
21	45	1	1	1,234	237,878	27,193,661.56	22,312,747.95	888,791,126.64	17,208,706.86	236,379,368.60	1,191,885,611.61	263.78	53.55	5,386.07	301.15	1,749.21	7,753.76

TableA-2 Financial analysis of BCR, NPV & IRR

YEAR		Investment Cost	Operating Cost(2.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	1	43,926.33	-	43,926.33	-	(43,926.33)	1.000000	43,926.330	-	-43,926.33	-43,926.33
	2	-	1,098.16	1,098.16	7,753.76	6,655.60	0.869565	954.922	6,742.40	5,787.48	(38,138.85)
	3	-	1,098.16	1,098.16	7,753.76	6,655.60	0.756144	830.367	5,862.96	5,032.59	(33,106.26)
	4	-	1,098.16	1,098.16	7,753.76	6,655.60	0.657516	722.058	5,098.22	4,376.16	(28,730.10)
	5	-	1,098.16	1,098.16	7,753.76	6,655.60	0.571753	627.876	4,433.24	3,805.36	(24,924.74)
	6	-	1,098.16	1,098.16	7,753.76	6,655.60	0.497177	545.980	3,854.99	3,309.01	(21,615.73)
	7	-	1,098.16	1,098.16	7,753.76	6,655.60	0.432328	474.765	3,352.17	2,877.40	(18,738.33)
	8		1,098.16	1,098.16	7,753.76	6,655.60	0.375937	412.839	2,914.93	2,502.09	(16,236.24)
	9	-	1,098.16	1,098.16	7,753.76	6,655.60	0.326902	358.991	2,534.72	2,175.73	(14,060.51)
	10	-	1,098.16	1,098.16	7,753.76	6,655.60	0.284262	312.165	2,204.10	1,891.93	(12,168.58)
	11	-	1,098.16	1,098.16	7,753.76	6,655.60	0.247185	271.449	1,916.61	1,645.16	(10,523.42)
	12	-	1,098.16	1,098.16	7,753.76	6,655.60	0.214943	236.042	1,666.62	1,430.57	(9,092.85)
	13	-	1,098.16	1,098.16	7,753.76	6,655.60	0.186907	205.254	1,449.23	1,243.98	(7,848.87)
	14	-	1,098.16	1,098.16	7,753.76	6,655.60	0.162528	178.482	1,260.20	1,081.72	(6,767.15)
	15	-	1,098.16	1,098.16	7,753.76	6,655.60	0.141329	155.202	1,095.83	940.63	(5,826.52)
	16	-	1,098.16	1,098.16	7,753.76	6,655.60	0.122894	134.957	952.89	817.93	(5,008.59)
	17	-	1,098.16	1,098.16	7,753.76	6,655.60	0.106865	117.355	828.61	711.25	(4,297.34)
	18	-	1,098.16	1,098.16	7,753.76	6,655.60	0.092926	102.048	720.53	618.48	(3,678.86)
	19	-	1,098.16	1,098.16	7,753.76	6,655.60	0.080805	88.737	626.54	537.81	(3,141.05)
	20	-	1,098.16	1,098.16	7,753.76	6,655.60	0.070265	77.162	544.82	467.66	(2,673.39)
	21	-	1,098.16	1,098.16	7,753.76	6,655.60	0.061100	67.098	473.75	406.66	(2,266.73)
								50,800.08	48,533.36		

BCR (F) :	0.96	
NPV @15% :	(2266.72)	LAKH TAKA
IRR :	13.87%	

Figure A-1: RATE OF RETURN

APPENDIX B: SITUATION-4

Table B-1 Annual value of output
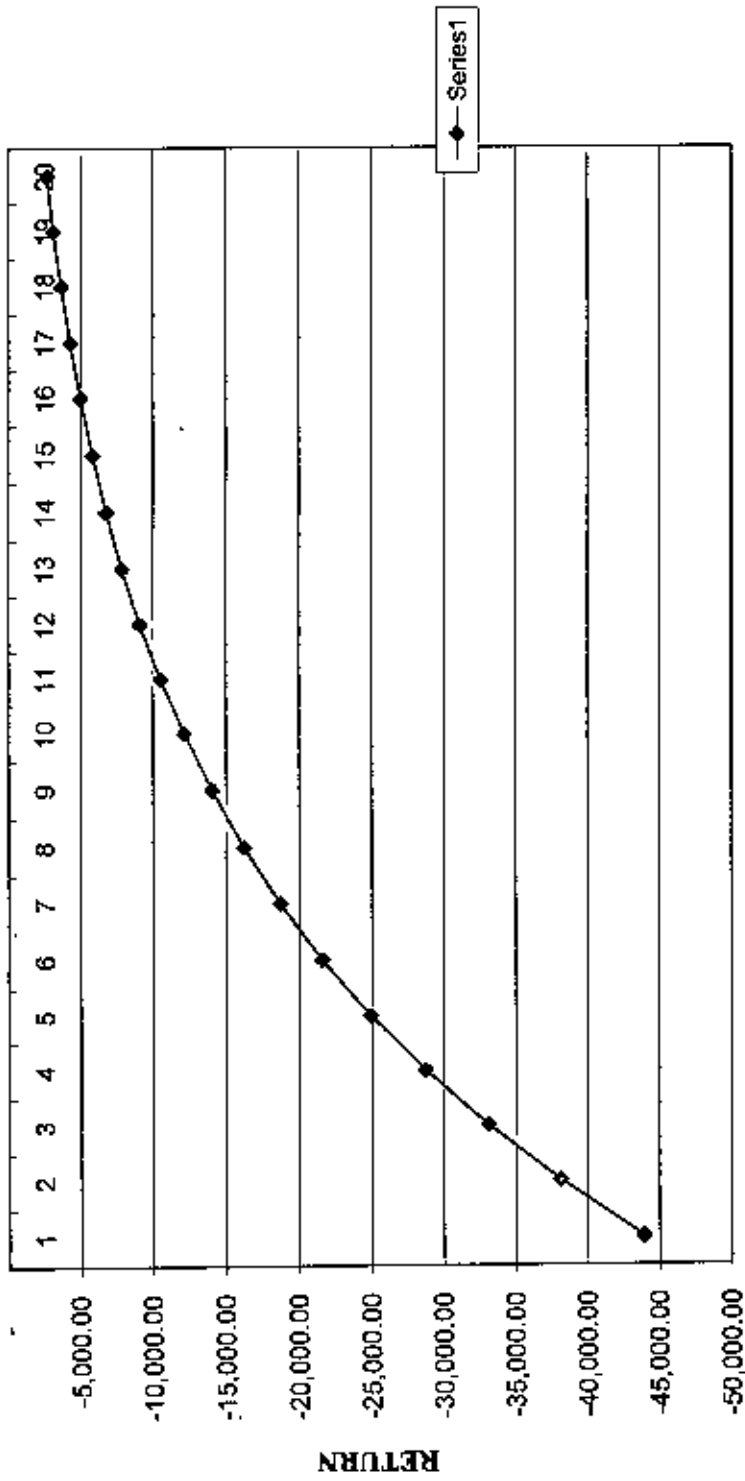
Table B-2 Financial analysis of BCR, NPV & IRR

(In Lakh Taka)

YEAR		Investment Cost	Operating Cost(2.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	1	43,926.33	-	43,926.33	-	(43,926.33)	1.000000	43,926.330	-	-43,926.33	-43,926.33
	2	-	1,098.16	1,098.16	8,286.46	7,188.30	0.869565	954.922	7,205.62	6,250.69	(37,675.64)
	3	-	1,098.16	1,098.16	8,569.94	7,471.78	0.756144	830.367	6,480.11	5,649.74	(32,025.90)
	4	-	1,098.16	1,098.16	8,569.94	7,471.78	0.657516	722.058	5,634.87	4,912.81	(27,113.09)
	5	-	1,098.16	1,098.16	8,569.94	7,471.78	0.571753	627.876	4,899.89	4,272.01	(22,841.08)
	6	-	1,098.16	1,098.16	8,569.94	7,471.78	0.497177	545.980	4,260.78	3,714.80	(19,126.28)
	7	-	1,098.16	1,098.16	8,569.94	7,471.78	0.432328	474.765	3,705.03	3,230.26	(15,896.02)
	8	-	1,098.16	1,098.16	8,569.94	7,471.78	0.375937	412.839	3,221.76	2,808.92	(13,087.10)
	9	-	1,098.16	1,098.16	8,569.94	7,471.78	0.326902	358.991	2,801.53	2,442.54	(10,644.56)
	10	-	1,098.16	1,098.16	8,569.94	7,471.78	0.284262	312.165	2,436.11	2,123.94	(8,520.62)
	11	-	1,098.16	1,098.16	8,569.94	7,471.78	0.247185	271.449	2,118.36	1,846.91	(6,673.71)
	12	-	1,098.16	1,098.16	8,569.94	7,471.78	0.214943	236.042	1,842.05	1,606.01	(5,067.70)
	13	-	1,098.16	1,098.16	8,569.94	7,471.78	0.186907	205.254	1,601.78	1,396.53	(3,671.17)
	14	-	1,098.16	1,098.16	8,569.94	7,471.78	0.162528	178.482	1,392.86	1,214.37	(2,456.80)
	15	-	1,098.16	1,098.16	8,569.94	7,471.78	0.141329	155.202	1,211.18	1,055.98	(1,400.82)
	16	-	1,098.16	1,098.16	8,569.94	7,471.78	0.122894	134.957	1,053.19	918.24	(482.58)
	17	-	1,098.16	1,098.16	8,569.94	7,471.78	0.106865	117.355	915.83	798.47	315.89
	18	-	1,098.16	1,098.16	8,569.94	7,471.78	0.092926	102.048	796.37	694.32	1,010.21
	19	-	1,098.16	1,098.16	8,569.94	7,471.78	0.080805	88.737	692.49	603.76	1,613.97
	20	-	1,098.16	1,098.16	8,569.94	7,471.78	0.070265	77.162	602.17	525.00	2,138.97
	21	-	1,098.16	1,098.16	8,569.94	7,471.78	0.061100	67.098	523.62	456.53	2,595.50
								50,800.08	53,395.60		

BCR (F): 1.05
NPV @15%: 2594.52 LAKH TAKA
IRR: 15.69%
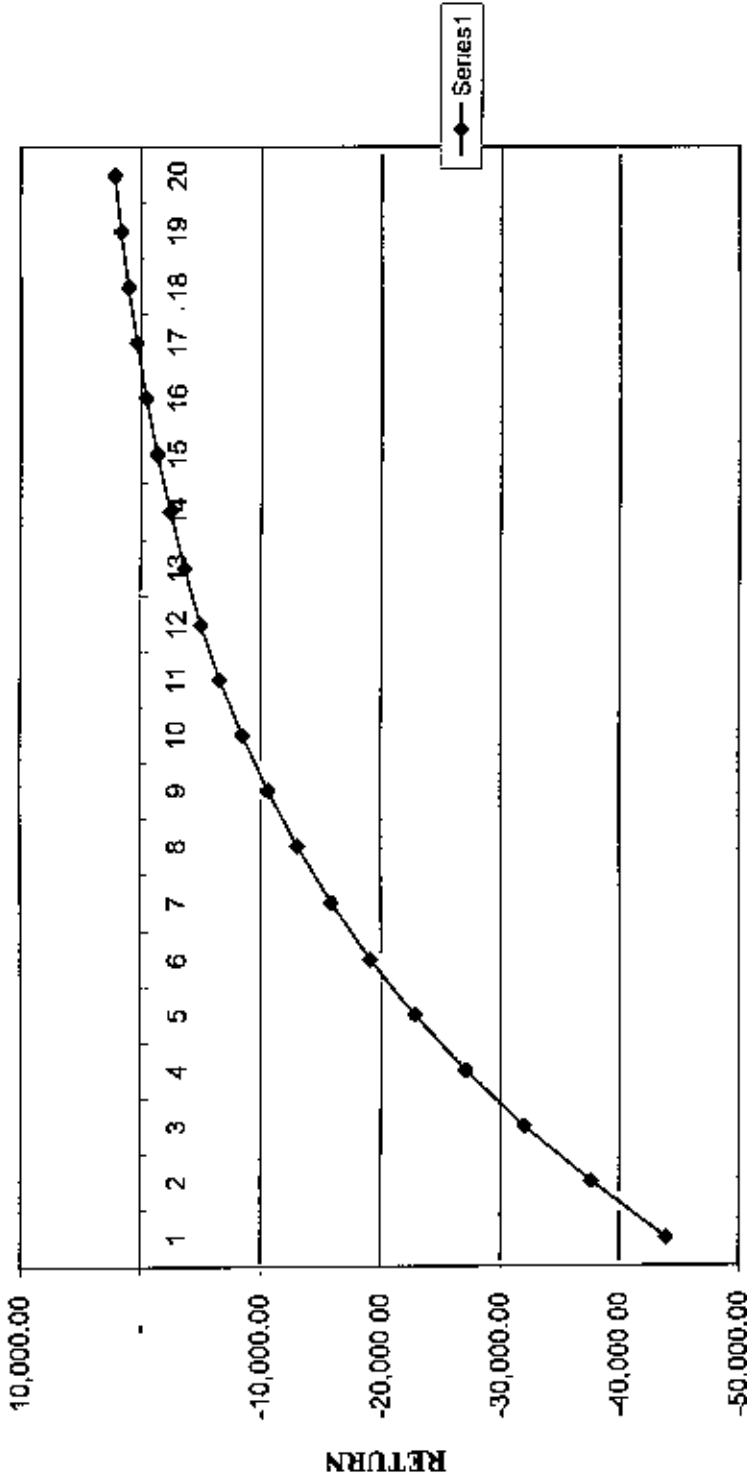
YEAR

Figure B-1: RATE OF RETURN

APPENDIX C: SITUATION-5

Table C-1 Annual value of output

Table C-2 Financial analysis of BCR , NPV & IRR

(In Lakh Taka)

YEAR		Investment Cost	Operating Cost (2.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	1	43,926.33	-	43,926.33	-	(43,926.33)	1.000000	43,926.330	-	-43,926.33	-43,926.33
	2	-	1,098.16	1,098.16	8,161.85	7,063.69	0.869565	954.922	7,097.26	6,142.34	(37,783.99)
	3	-	1,098.16	1,098.16	8,569.94	7,471.78	0.756144	830.367	6,480.11	5,649.74	(32,134.25)
	4	-	1,098.16	1,098.16	8,569.94	7,471.78	0.657516	722.058	5,634.87	4,912.81	(27,221.44)
	5	-	1,098.16	1,098.16	8,569.94	7,471.78	0.571753	627.876	4,899.89	4,272.01	(22,949.43)
	6	-	1,098.16	1,098.16	8,569.94	7,471.78	0.497177	545.980	4,260.78	3,714.80	(19,234.63)
	7	-	1,098.16	1,098.16	8,569.94	7,471.78	0.432328	474.765	3,705.03	3,230.26	(16,004.37)
	8		1,098.16	1,098.16	8,569.94	7,471.78	0.375937	412.839	3,221.76	2,808.92	(13,195.45)
	9	-	1,098.16	1,098.16	8,569.94	7,471.78	0.326902	358.991	2,801.53	2,442.54	(10,752.91)
	10	-	1,098.16	1,098.16	8,569.94	7,471.78	0.284262	312.165	2,436.11	2,123.94	(8,628.97)
	11	-	1,098.16	1,098.16	8,569.94	7,471.78	0.247185	271.449	2,118.36	1,846.91	(6,782.06)
	12	-	1,098.16	1,098.16	8,569.94	7,471.78	0.214943	236.042	1,842.05	1,606.01	(5,176.05)
	13	-	1,098.16	1,098.16	8,569.94	7,471.78	0.186907	205.254	1,601.78	1,396.53	(3,779.52)
	14	-	1,098.16	1,098.16	8,569.94	7,471.78	0.162528	178.482	1,392.86	1,214.37	(2,565.15)
	15	-	1,098.16	1,098.16	8,569.94	7,471.78	0.141329	155.202	1,211.18	1,055.98	(1,509.17)
	16	-	1,098.16	1,098.16	8,569.94	7,471.78	0.122894	134.957	1,053.19	918.24	(590.93)
	17	-	1,098.16	1,098.16	8,569.94	7,471.78	0.106865	117.355	915.83	798.47	207.54
	18	-	1,098.16	1,098.16	8,569.94	7,471.78	0.092926	102.048	796.37	694.32	901.86
	19	-	1,098.16	1,098.16	8,569.94	7,471.78	0.080805	88.737	692.49	603.76	1,505.62
	20	-	1,098.16	1,098.16	8,569.94	7,471.78	0.070265	77.162	602.17	525.00	2,030.62
	21	-	1,098.16	1,098.16	8,569.94	7,471.78	0.061100	67.098	523.62	456.53	2,487.15
								50,800.08	53,287.24		

BCR (F) :	1.05
NPV @15% :	2487.16 LAKH TAKA
IRR :	16.01%

-79-
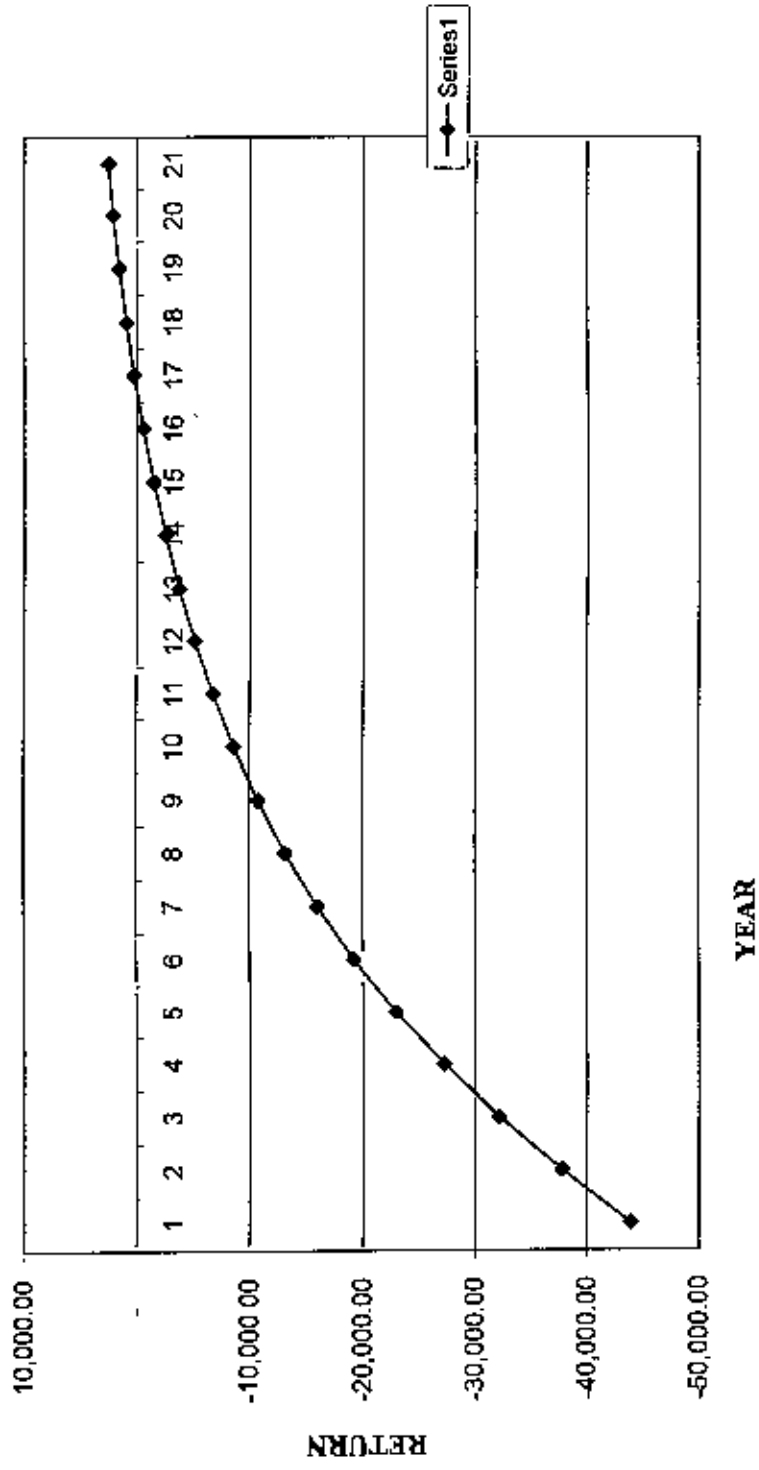
Figure C-1 : RATE OF RETURN

Table D-1 Annual value of output

Table D-2 Financial analysis of BCR , NPV & IRR

(In Lakh Taka)

YEAR		Investment Cost	Operating Cost(1.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	1	43,926.33	-	43,926.33	-	(43,926.33)	1.000000	43,926.330	-	-43,926.33	-43,926.33
	2	-	1,098.16	1,098.16	8,161.85	7,063.69	0.869565	954.922	7,097.26	6,142.34	(37,783.99)
	3	-	1,098.16	1,098.16	8,978.05	7,879.89	0.756144	830.367	6,788.70	5,958.33	(31,825.66)
	4	-	1,098.16	1,098.16	8,978.05	7,879.89	0.657516	722.058	5,903.21	5,181.15	(26,644.51)
	5	-	1,098.16	1,098.16	8,978.05	7,879.89	0.571753	627.876	5,133.23	4,505.35	(22,139.16)
	6	-	1,098.16	1,098.16	8,978.05	7,879.89	0.497177	545.980	4,463.68	3,917.70	(18,221.46)
	7	-	1,098.16	1,098.16	8,978.05	7,879.89	0.432328	474.765	3,881.46	3,406.70	(14,814.76)
	8	-	1,098.16	1,098.16	8,978.05	7,879.89	0.375937	412.839	3,375.18	2,962.34	(11,852.42)
	9	-	1,098.16	1,098.16	8,978.05	7,879.89	0.326902	358.991	2,934.94	2,575.95	(9,276.47)
	10	-	1,098.16	1,098.16	8,978.05	7,879.89	0.284262	312.165	2,552.12	2,239.95	(7,036.52)
	11	-	1,098.16	1,098.16	8,978.05	7,879.89	0.247185	271.449	2,219.24	1,947.79	(5,088.73)
	12	-	1,098.16	1,098.16	8,978.05	7,879.89	0.214943	236.042	1,929.77	1,693.73	(3,395.00)
	13	-	1,098.16	1,098.16	8,978.05	7,879.89	0.186907	205.254	1,678.06	1,472.81	(1,922.19)
	14	-	1,098.16	1,098.16	8,978.05	7,879.89	0.162528	178.482	1,459.18	1,280.70	(641.49)
	15	-	1,098.16	1,098.16	8,978.05	7,879.89	0.141329	155.202	1,268.86	1,113.66	472.17
	16	-	1,098.16	1,098.16	8,978.05	7,879.89	0.122894	134.957	1,103.35	968.39	1,440.56
	17	-	1,098.16	1,098.16	8,978.05	7,879.89	0.106865	117.355	959.44	842.08	2,282.64
	18	-	1,098.16	1,098.16	8,978.05	7,879.89	0.092926	102.048	834.29	732.25	3,014.89
	19	-	1,098.16	1,098.16	8,978.05	7,879.89	0.080805	88.737	725.47	636.73	3,651.62
	20	-	1,098.16	1,098.16	8,978.05	7,879.89	0.070265	77.162	630.84	553.68	4,205.30
	21	-	1,098.16	1,098.16	8,978.05	7,879.89	0.061100	67.098	548.56	481.46	4,686.76
								50,800.08	55,486.84		

BCR (F) :   1.09
NPV @15% : 4686.76   LAKH TAKA
IRR :   16.88%
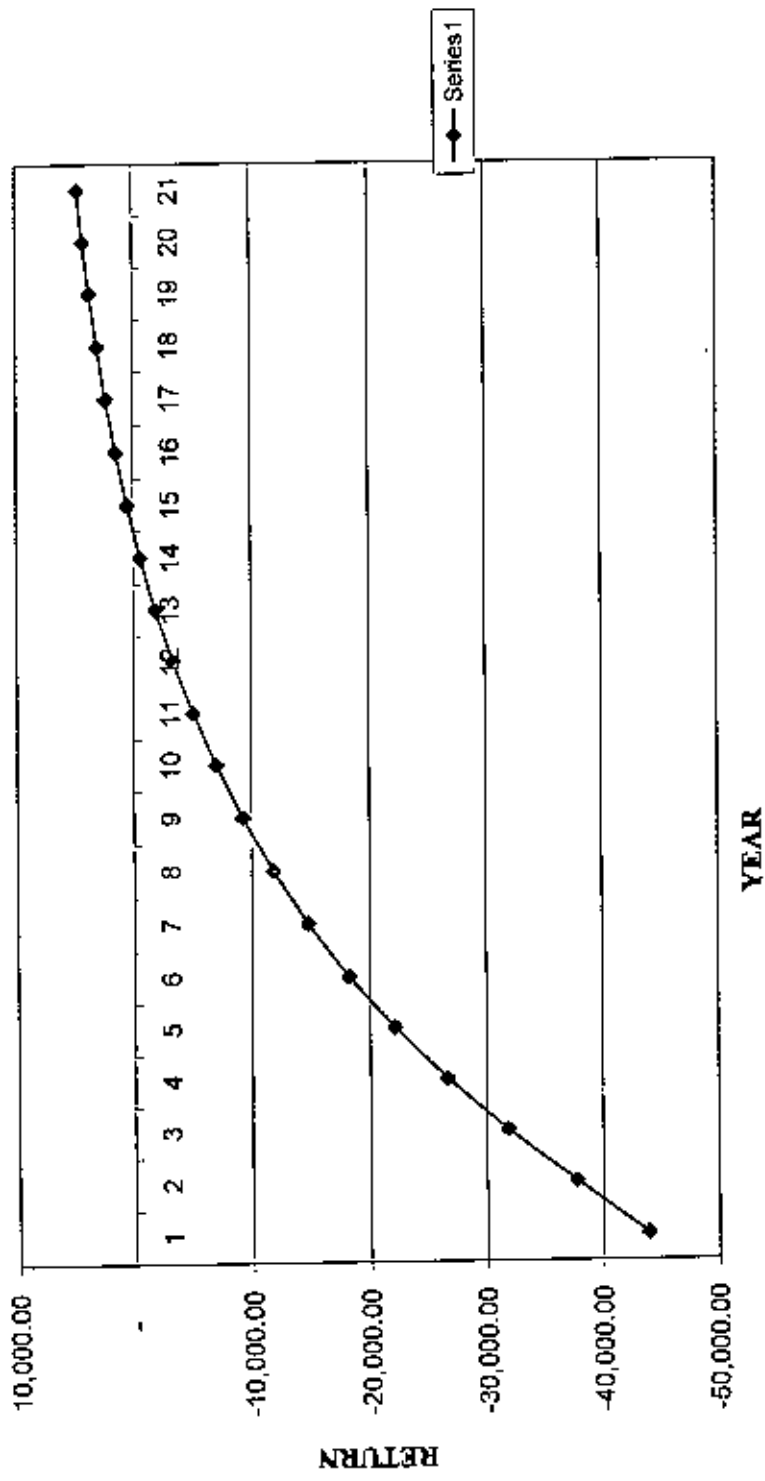
Figure D-1: RATE OF RETURN

APPENDIX E: SITUATION-7

Table E-1: Annual value of output

Table E-2: Financial analysis of BCR, NPV & IRR

(In Lakh Taka)

YEAR	Investment Cost	Operating Cost(2.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	1	43,926.33	-	43,926.33	-	(43,926.33)	1.000000	43,926.330	-	-43,926.33	-43,926.33
2	-	1,098.16	1,098.16	8,161.85	7,063.69	0.869565	954.922	7,097.26	6,142.34	(37,783.99)
3	-	1,098.16	1,098.16	9,794.22	8,696.06	0.756144	830.367	7,405.84	6,575.47	(31,208.52)
4	-	1,098.16	1,098.16	9,794.22	8,696.06	0.657516	722.058	6,439.86	5,717.80	(25,490.72)
5	-	1,098.16	1,098.16	9,794.22	8,696.06	0.571753	627.876	5,599.87	4,972.00	(20,518.72)
6	-	1,098.16	1,098.16	9,794.22	8,696.06	0.497177	545.980	4,869.46	4,323.48	(16,195.24)
7		1,098.16	1,098.16	9,794.22	8,696.06	0.432328	474.765	4,234.32	3,759.55	(12,435.69)
8		1,098.16	1,098.16	9,794.22	8,696.06	0.375937	412.839	3,682.01	3,269.17	(9,166.52)
9		1,098.16	1,098.16	9,794.22	8,696.06	0.326902	358.991	3,201.75	2,842.76	(6,323.76)
10		1,098.16	1,098.16	9,794.22	8,696.06	0.284262	312.165	2,784.12	2,471.96	(3,851.80)
11		1,098.16	1,098.16	9,794.22	8,696.06	0.247185	271.449	2,420.98	2,149.54	(1,702.26)
12		1,098.16	1,098.16	9,794.22	8,696.06	0.214943	236.042	2,105.20	1,869.16	166.90
13		1,098.16	1,098.16	9,794.22	8,696.06	0.186907	205.254	1,830.61	1,625.35	1,792.25
14		1,098.16	1,098.16	9,794.22	8,696.06	0.162528	178.482	1,591.83	1,413.35	3,205.60
15		1,098.16	1,098.16	9,794.22	8,696.06	0.141329	155.202	1,384.21	1,229.01	4,434.61
16		1,098.16	1,098.16	9,794.22	8,696.06	0.122894	134.957	1,203.65	1,068.69	5,503.30
17		1,098.16	1,098.16	9,794.22	8,696.06	0.106865	117.355	1,046.66	929.30	6,432.60
18		1,098.16	1,098.16	9,794.22	8,696.06	0.092926	102.048	910.14	808.09	7,240.69
19		1,098.16	1,098.16	9,794.22	8,696.06	0.080805	88.737	791.42	702.69	7,943.38
20		1,098.16	1,098.16	9,794.22	8,696.06	0.070265	77.162	688.19	611.03	8,554.41
21		1,098.16	1,098.16	9,794.22	8,696.06	0.061100	67.098	598.43	531.33	9,085.74
							50,800.08	59,885.81		

BCR (F): 1.18
NPV @15%: 9085.73
IRR: 18.56%

LAKH TAKA

-85-
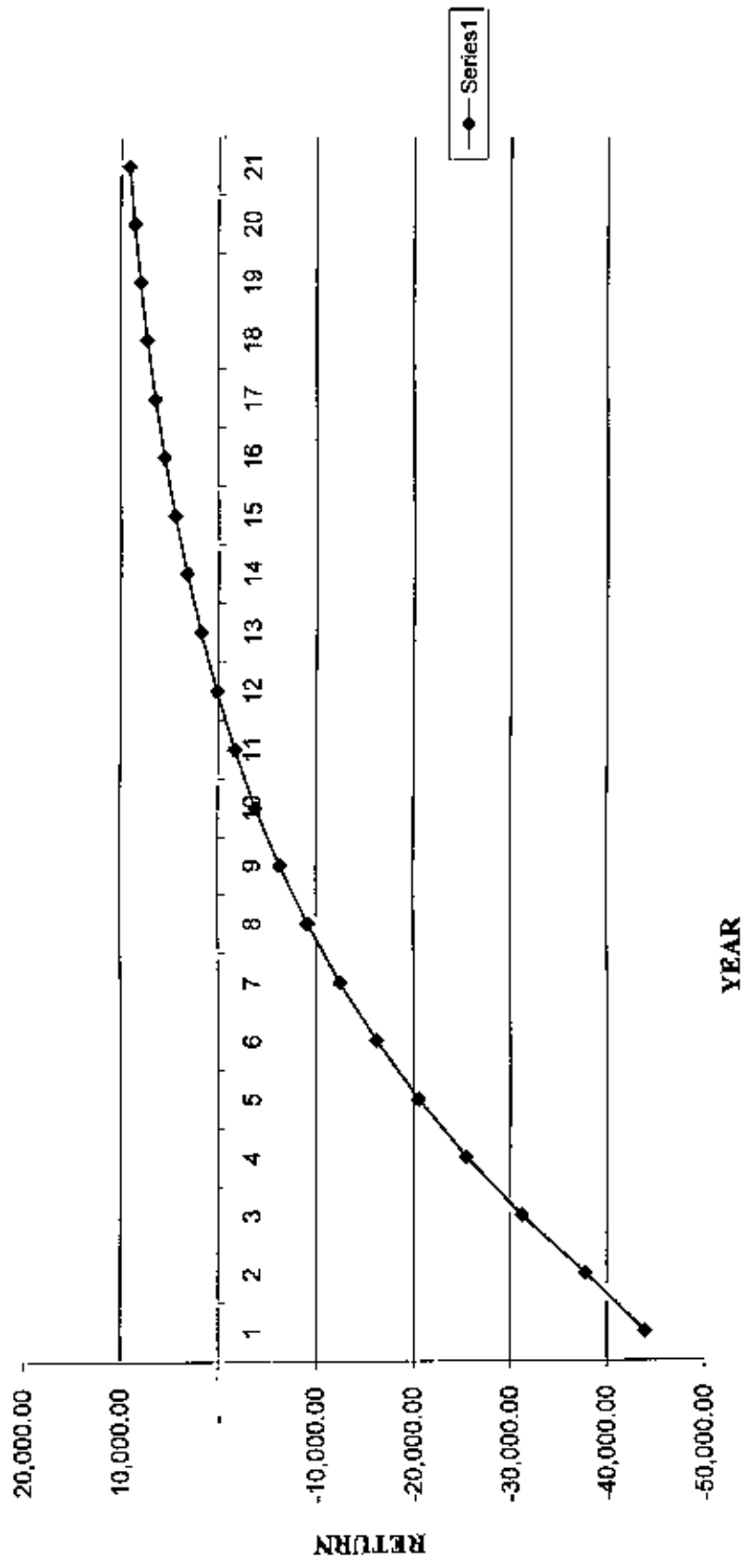
YEAR

Figure E-1: RATE OF RETURN

APPENDIX F: SITUATION-8

Table F-1: Annual value of output

Table F-2: Financial anlysis of BCR, NPV & IRR

(In Lakh Taka)

YEAR		Investment Cost	Operating Cost(2.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	1	43,926.33	-	43,926.33	-	(43,926.33)	1.000000	43,926.330	-	-43,926.33	-43,926.33
	2	-	1,098.16	1,098.16	8,161.85	7,063.69	0.869565	954.922	7,097.26	6,142.34	(37,783.99)
	3	-	1,098.16	1,098.16	10,202.32	9,104.16	0.756144	830.367	7,714.42	6,884.06	(30,899.93)
	4	-	1,098.16	1,098.16	10,202.32	9,104.16	0.657516	722.058	6,708.19	5,986.13	(24,913.80)
	5	-	1,098.16	1,098.16	10,202.32	9,104.16	0.571753	627.876	5,833.21	5,205.33	(19,708.47)
	6	-	1,098.16	1,098.16	10,202.32	9,104.16	0.497177	545.980	5,072.36	4,526.38	(15,182.09)
	7	-	1,098.16	1,098.16	10,202.32	9,104.16	0.432328	474.765	4,410.75	3,935.98	(11,246.11)
	8	-	1,098.16	1,098.16	10,202.32	9,104.16	0.375937	412.839	3,835.43	3,422.59	(7,823.52)
	9	-	1,098.16	1,098.16	10,202.32	9,104.16	0.326902	358.991	3,335.16	2,976.17	(4,847.35)
	10	-	1,098.16	1,098.16	10,202.32	9,104.16	0.284262	312.165	2,900.13	2,587.97	(2,259.38)
	11	-	1,098.16	1,098.16	10,202.32	9,104.16	0.247185	271.449	2,521.86	2,250.41	(8.97)
	12	-	1,098.16	1,098.16	10,202.32	9,104.16	0.214943	236.042	2,192.92	1,956.88	1,947.91
	13	-	1,098.16	1,098.16	10,202.32	9,104.16	0.186907	205.254	1,906.89	1,701.63	3,649.54
	14	-	1,098.16	1,098.16	10,202.32	9,104.16	0.162528	178.482	1,658.16	1,479.68	5,129.22
	15	-	1,098.16	1,098.16	10,202.32	9,104.16	0.141329	155.202	1,441.88	1,286.68	6,415.90
	16	-	1,098.16	1,098.16	10,202.32	9,104.16	0.122894	134.957	1,253.80	1,118.85	7,534.75
	17	-	1,098.16	1,098.16	10,202.32	9,104.16	0.106865	117.355	1,090.27	972.92	8,507.67
	18	-	1,098.16	1,098.16	10,202.32	9,104.16	0.092926	102.048	948.06	846.01	9,353.68
	19	-	1,098.16	1,098.16	10,202.32	9,104.16	0.080805	88.737	824.40	735.66	10,089.34
	20	-	1,098.16	1,098.16	10,202.32	9,104.16	0.070265	77.162	716.87	639.70	10,729.04
	21	-	1,098.16	1,098.16	10,202.32	9,104.16	0.061100	67.098	623.36	556.26	11,285.30
								50,800.08	62,085.38		

BCR (F) :   1.23
NPV @15% :   11285.30   LAKH TAKA
IRR :   19.37%

Figure F-1: RATE OF RETURN

APPENDIX G: SITUATION $

Table G-1: Annual value of output

Table G-2: Financial analysis of BCR, NPV & IRR

(In Lakh Taka)

YEAR		Investment Cost	Operating Cost(2.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	1	43,926.33	-	43,926.33	-	(43,926.33)	1.000000	43,926.330	-	-43,926.33	-43,926.33
	2	-	1,098.16	1,098.16	8,161.85	7,063.69	0.869565	954.922	7,097.26	6,142.34	(37,783.99)
	3	-	1,098.16	1,098.16	10,610.41	9,512.25	0.756144	830.367	8,023.00	7,192.63	(30,591.36)
	4	-	1,098.16	1,098.16	10,610.41	9,512.25	0.657516	722.058	6,976.51	6,254.46	(24,336.90)
	5	-	1,098.16	1,098.16	10,610.41	9,512.25	0.571753	627.876	6,066.53	5,438.66	(18,898.24)
	6	-	1,098.16	1,098.16	10,610.41	9,512.25	0.497177	545.980	5,275.25	4,729.27	(14,168.97)
	7	-	1,098.16	1,098.16	10,610.41	9,512.25	0.432328	474.765	4,587.18	4,112.41	(10,056.56)
	8	-	1,098.16	1,098.16	10,610.41	9,512.25	0.375937	412.839	3,988.85	3,576.01	(6,480.55)
	9	-	1,098.16	1,098.16	10,610.41	9,512.25	0.326902	358.991	3,468.56	3,109.57	(3,370.98)
	10	-	1,098.16	1,098.16	10,610.41	9,512.25	0.284262	312.165	3,016.14	2,703.97	(667.01)
	11	-	1,098.16	1,098.16	10,610.41	9,512.25	0.247185	271.449	2,622.73	2,351.29	1,684.28
	12	-	1,098.16	1,098.16	10,610.41	9,512.25	0.214943	236.042	2,280.63	2,044.59	3,728.87
	13	-	1,098.16	1,098.16	10,610.41	9,512.25	0.186907	205.254	1,983.16	1,777.91	5,506.78
	14	-	1,098.16	1,098.16	10,610.41	9,512.25	0.162528	178.482	1,724.49	1,546.01	7,052.79
	15	-	1,098.16	1,098.16	10,610.41	9,512.25	0.141329	155.202	1,499.56	1,344.36	8,397.15
	16	-	1,098.16	1,098.16	10,610.41	9,512.25	0.122894	134.957	1,303.96	1,169.00	9,566.15
	17	-	1,098.16	1,098.16	10,610.41	9,512.25	0.106865	117.355	1,133.88	1,016.53	10,582.68
	18	-	1,098.16	1,098.16	10,610.41	9,512.25	0.092926	102.048	985.98	883.94	11,466.62
	19	-	1,098.16	1,098.16	10,610.41	9,512.25	0.080805	88.737	857.37	768.64	12,235.26
	20	-	1,098.16	1,098.16	10,610.41	9,512.25	0.070265	77.162	745.54	668.38	12,903.64
	21	-	1,098.16	1,098.16	10,610.41	9,512.25	0.061100	67.098	648.30	581.20	13,484.84
								50,800.03	64,284.88		

BCR (F) : 1.27
NPV @15% : 13484.80   LAKH TAKA
IRR : 20.17%
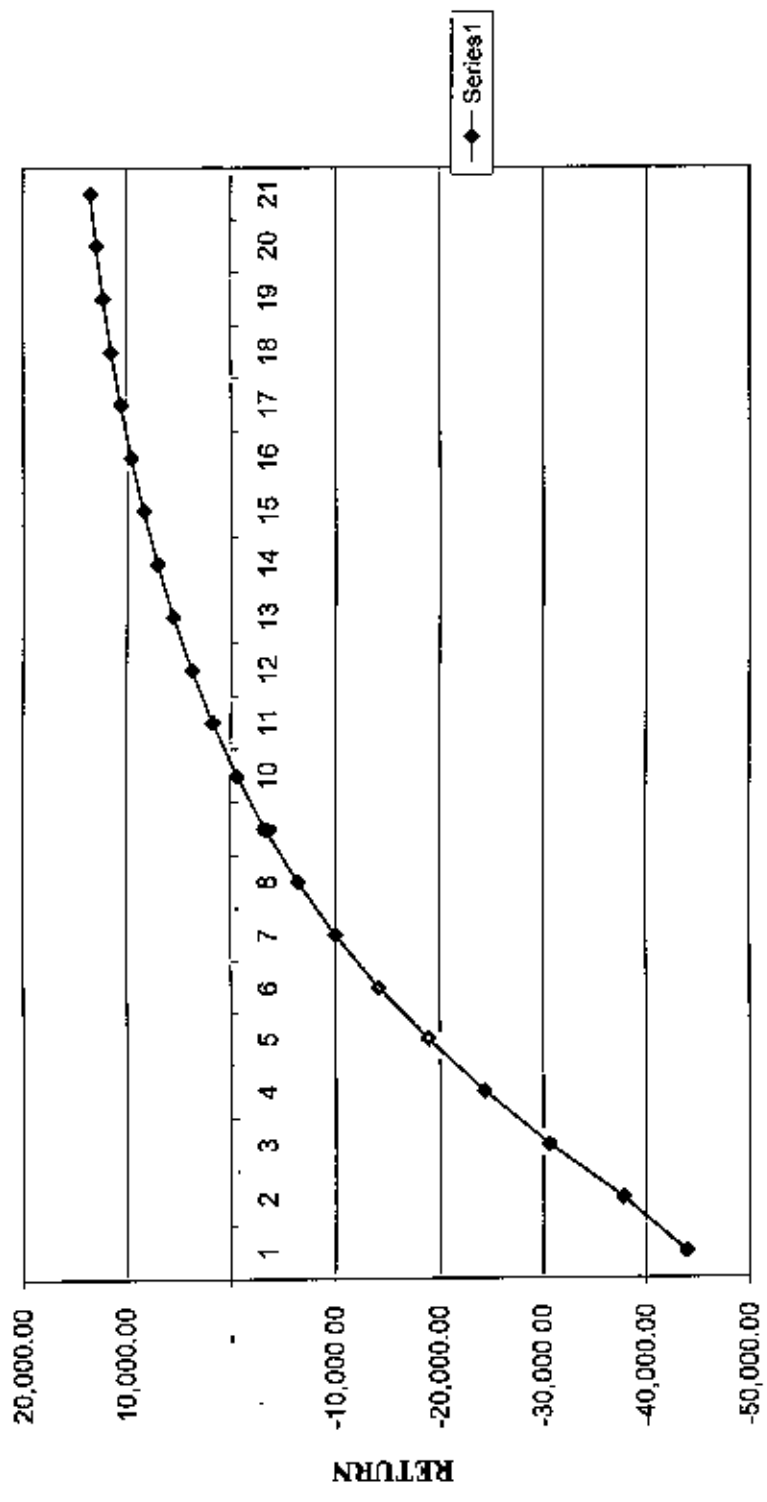
YEAR

Figure G-1: RATE OF RETURN

APPENDIX H: SITUATION-10

Table H-1 Annual value of output

Table H-2: Financial analysis of BCR , NPV & IRR

(In Lakh Taka)

YEAR		Investment Cost	Operating Cost(2.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	1	29,059.54	-	29,059.54	-	(29,059 54)	1 000000	29,059 540	-	-29,059 54	-29,059.54
	2	-	726 49	726.49	3,859 00	3,132 51	0 869565	631.730	3,355 65	2,723 92	(26,335 62)
	3	-	726 49	726.49	5,402.59	4,676 10	0.756144	549.331	4,085.14	3,535 80	(22,799 82)
	4	-	726 49	726.49	5,834 79	5,108 30	0 657516	477 679	3,836 47	3,358.79	(19,441 03)
	5	-	726 49	726 49	6,301 57	5,575 08	0.571753	415.373	3,602 94	3,187 57	(16,253 46)
	6	-	726 49	726 49	6,805 71	6,079 22	0 497177	361.194	3,383 64	3,022 45	(13,231 01)
	7	-	726 49	726 49	7,350 17	6,623 68	0.432328	314 082	3,177 68	2,863 60	(10,367 41)
	8		726.49	726 49	7,717 98	6,991 49	0 375937	273.114	2,901 47	2,628 36	(7,739 05)
	9	-	726 49	726,49	7,717,98	6,991 49	0 326902	237 491	2,523 02	2,285 53	(5,453 52)
	10	-	726 49	726 49	7,717,98	6,991 49	0 284262	206 514	2,193 93	1,987 41	(3,466 11)
	11	-	726 49	726 49	7,717 98	6,991 49	0 247185	179 577	1,907 77	1,728 19	(1,737 92)
	12	-	726 49	726 49	7,717,98	6,991 49	0 214943	156,154	1,658 93	1,502,77	(235 15)
	13	-	726,49	726 49	7,717,98	6,991,49	0 186907	135 786	1,442 54	1,306 76	1,071 61
	14	-	726 49	726 49	7,717 98	6,991 49	0 162528	118 075	1,254,39	1,136.31	2,207,92
	15	-	726 49	726 49	7,717,98	6,991.49	0 141329	102 674	1,090 77	988.10	3,196 02
	16	-	726,49	726.49	7,717,98	6,991.49	0 122894	89 281	948 49	859 21	4,055 23
	17	-	726.49	726,49	7,717,98	6,991.49	0 106865	77 636	824.78	747.15	4,802 38
	18	-	726 49	726 49	7,717 98	6,991 49	0 092926	67.510	717 20	649.69	5,452 07
	19	-	726.49	726,49	7,717,98	6,991 49	0 080805	58 704	623 65	564.95	6,017 02
	20	-	726 49	726 49	7,717 98	6,991 49	0 070265	51 047	542 30	491.26	6,508 28
	21	-	726 49	726,49	7,717,98	6,991 49	0 061100	44 389	471 57	427.18	6,935 46
								33,606 88	40,542 33		

BCR (b) :	1.21	
NPV @15% :	6935.45	LAKH TAKA
IRR :	18.61%	
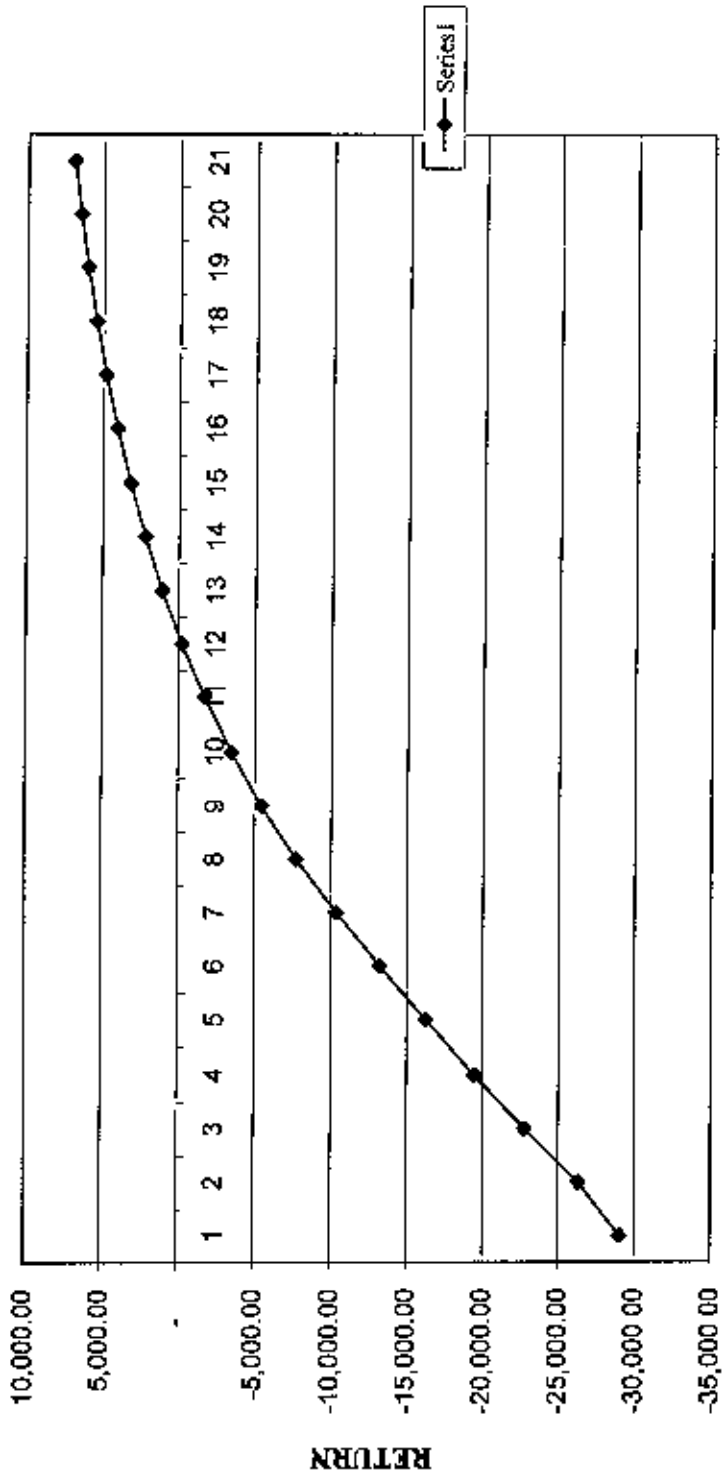
YEAR

Figure H-1: RATE OF RETURN

APPENDIX I: SITUATION-II

Table I-1: Annual value of output

YEAR	No. of Customers					Consumption (KWh)						Annual Value of output					Total Benefit
	Ind.	Power Station	Captive	Com.	Dom.	Ind.	Power Station	Captive	Com.	Dom.	Total	Ind.	Power Station	Cap.	Com.	Dom.	(Lakh taka)
2008-09																	
2	45	1	1	1,234	233,011	15,673,676.11	11,238,779.13	491,174,043.47	9,315,874.84	127,958,539.80	656,071,463.37	143.77	28.79	2,778.31	144.45	948.89	4,243.19
3	45	1	1	1,234	233,011	21,099,306.15	11,263,020.78	487,443,441.14	13,314,104.79	178,141,955.72	711,139,073.32	204.08	41.41	4,157.12	223.08	1,321.61	5,972.21
4	45	1	1	1,234	233,011	22,772,451.11	11,644,082.44	742,655,154.05	14,179,231.16	197,477,312.18	979,278,159.05	229.41	44.75	6,300.49	231.44	1,433.78	8,441.99
5	45	1	1	1,234	233,011	24,240,247.38	20,133,587.44	882,057,566.33	15,279,373.81	204,071,177.13	1,071,085,383.11	219.06	49.21	6,080.31	271.72	1,348.24	6,964.91
6	45	1	1	1,234	233,012	26,501,444.98	31,246,434.44	846,223,771.49	16,771,937.33	223,647,231.27	1,113,173,447.31	257.08	32.19	5,249.37	393.11	1,409.94	7,372.09
7	45	1	1	1,234	233,012	28,623,744.34	23,496,149.38	935,331,879.79	18,313,893.33	245,720,431.07	1,275,989,499.31	272.43	36.37	5,469.73	314.99	1,803.33	8,323.84
8	45	1	1	1,234	233,012	30,056,152.23	24,661,458.26	982,345,087.34	19,028,149.64	235,917,079.68	1,287,341,448.17	291.34	39.19	5,951.07	372.05	1,899.79	8,530.49
9	45	1	1	1,234	233,012	30,056,152.23	24,661,458.26	982,345,087.34	19,028,149.64	235,917,079.68	1,287,341,448.17	291.34	39.19	5,951.07	372.05	1,899.79	8,530.49
10	45	1	1	1,234	233,012	30,056,152.23	24,661,458.26	982,345,087.34	19,028,149.64	235,917,079.68	1,287,341,448.17	291.34	39.19	5,951.07	372.05	1,899.79	8,530.49
11	45	1	1	1,234	233,012	30,056,152.23	24,661,458.26	982,345,087.34	19,028,149.64	235,917,079.68	1,287,341,448.17	291.34	39.19	5,951.07	372.05	1,899.79	8,530.49
12	45	1	1	1,234	233,012	30,056,152.23	24,661,458.26	982,345,087.34	19,028,149.64	235,917,079.68	1,287,341,448.17	291.34	39.19	5,951.07	372.05	1,899.79	8,530.49
13	45	1	1	1,234	233,012	30,056,152.23	24,661,458.26	982,345,087.34	19,028,149.64	235,917,079.68	1,287,341,448.17	291.34	39.19	5,951.07	372.05	1,899.79	8,530.49
14	45	1	1	1,234	233,012	30,056,152.23	24,661,458.26	982,345,087.34	19,028,149.64	235,917,079.68	1,287,341,448.17	291.34	39.19	5,951.07	372.05	1,899.79	8,530.49
15	45	1	1	1,234	233,012	30,056,152.23	24,661,458.26	982,345,087.34	19,028,149.64	235,917,079.68	1,287,341,448.17	291.34	39.19	5,951.07	372.05	1,899.79	8,530.49
16	45	1	1	1,234	233,012	30,056,152.23	24,661,458.26	982,345,087.34	19,028,149.64	235,917,079.68	1,287,341,448.17	291.34	39.19	5,951.07	372.05	1,899.79	8,530.49
17	45	1	1	1,234	233,012	30,056,152.23	24,661,458.26	982,345,087.34	19,028,149.64	235,917,079.68	1,287,341,448.17	291.34	39.19	5,951.07	372.05	1,899.79	8,530.49
18	45	1	1	1,234	233,012	30,056,152.23	24,661,458.26	982,345,087.34	19,028,149.64	235,917,079.68	1,287,341,448.17	291.34	39.19	5,951.07	372.05	1,899.79	8,530.49
19	45	1	1	1,234	233,011	30,056,152.23	24,661,458.26	982,345,087.34	19,028,149.64	235,917,079.68	1,287,341,448.17	291.34	39.19	5,951.07	372.05	1,899.79	8,530.49
20	45	1	1	1,234	233,011	30,056,152.23	24,661,458.26	982,345,087.34	19,028,149.64	235,917,079.68	1,287,341,448.17	291.34	39.19	5,951.07	372.05	1,899.79	8,530.49
21	45	1	1	1,234	233,011	30,056,152.23	24,661,458.26	982,345,087.34	19,028,149.64	235,917,079.68	1,287,341,448.17	291.34	39.19	5,951.07	372.05	1,899.79	8,530.49

Table I-2: Financial analysis of BCR , NPV & IRR

(In Lakh Taka)

YEAR		Investment Cost	Operating Cost(2.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	1	29,059.54	-	29,059.54	-	(29,059.54)	1.000000	29,059.540	-	-29,059.54	-29,059.54
	2	-	726.49	726.49	4,265.19	3,538.70	0.869565	631.730	3,708.86	3,077.13	(25,982.41)
	3	-	726.49	726.49	5,971.28	5,244.79	0.756144	549.331	4,515.15	3,965.82	(22,016.59)
	4	-	726.49	726.49	6,448.99	5,722.50	0.657516	477.679	4,240.31	3,762.64	(18,253.95)
	5	-	726.49	726.49	6,964.91	6,238.42	0.571753	415.373	3,982.21	3,566.84	(14,687.11)
	6	-	726.49	726.49	7,522.09	6,795.60	0.497177	361.194	3,739.81	3,378.62	(11,308.49)
	7	-	726.49	726.49	8,123.86	7,397.37	0.432328	314.082	3,512.17	3,198.09	(8,110.40)
	8	-	726.49	726.49	8,530.40	7,803.91	0.375937	273.114	3,206.89	2,933.78	(5,176.62)
	9	-	726.49	726.49	8,530.40	7,803.91	0.326902	237.491	2,788.60	2,551.11	(2,625.51)
	10	-	726.49	726.49	8,530.40	7,803.91	0.284262	206.514	2,424.87	2,218.36	(407.15)
	11	-	726.49	726.49	8,530.40	7,803.91	0.247185	179.577	2,108.59	1,929.01	1,521.86
	12	-	726.49	726.49	8,530.40	7,803.91	0.214943	156.154	1,833.55	1,677.40	3,199.26
	13	-	726.49	726.49	8,530.40	7,803.91	0.186907	135.786	1,594.39	1,458.61	4,657.87
	14	-	726.49	726.49	8,530.40	7,803.91	0.162528	118.075	1,386.43	1,268.35	5,926.22
	15	-	726.49	726.49	8,530.40	7,803.91	0.141329	102.674	1,205.59	1,102.92	7,029.14
	16	-	726.49	726.49	8,530.40	7,803.91	0.122894	89.281	1,048.33	959.05	7,988.19
	17	-	726.49	726.49	8,530.40	7,803.91	0.106865	77.636	911.60	833.96	8,822.15
	18	-	726.49	726.49	8,530.40	7,803.91	0.092926	67.510	792.70	725.19	9,547.34
	19	-	726.49	726.49	8,530.40	7,803.91	0.080805	58.704	689.30	630.59	10,177.93
	20	-	726.49	726.49	8,530.40	7,803.91	0.070265	51.047	599.39	548.34	10,726.27
	21	-	726.49	726.49	8,530.40	7,803.91	0.061100	44.389	521.21	476.82	11,203.09
								33,606.88	44,809.95		

BCR (F) :   1.33
NPV @15% :   11203.07   LAKH TAKA
IRR :   20.72%
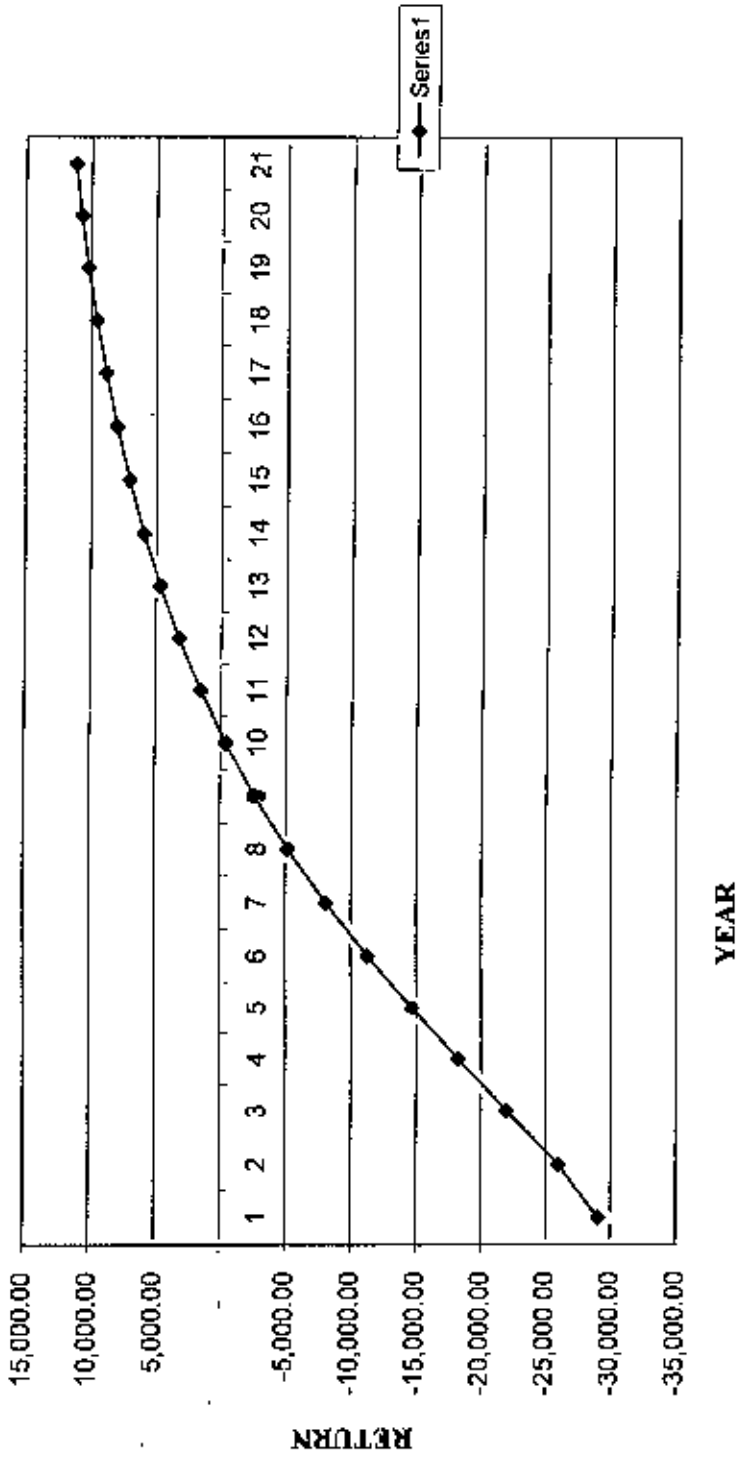
Figure I-1: RATE OF RETURN

APPENDIX J: SITUATION-12

Table J-1: Annual value of output

Table J-2: Financial analysis of BCR , NPV & IRR

(In Lakh Taka)

YEAR		Investment Cost	Operating Cost(2.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	1	29,059.54	-	29,059.54		(29,059.54)	1.000000	29,059.540	-	-29,059.54	-29,059.54
	2	-	726.49	726.49	4,062.09	3,335.60	0.869565	631.730	3,532.25	2,900.52	(26,159.02)
	3	-	726.49	726.49	5,971.28	5,244.79	0.756144	549.331	4,515.15	3,965.82	(22,193.20)
	4	-	726.49	726.49	6,448.99	5,722.50	0.657516	477.679	4,240.31	3,762.64	(18,430.56)
	5	-	726.49	726.49	6,964.91	6,238.42	0.571753	415.373	3,982.21	3,566.84	(14,863.72)
	6	-	726.49	726.49	7,522.09	6,795.60	0.497177	361.194	3,739.81	3,378.62	(11,485.10)
	7	-	726.49	726.49	8,123.86	7,397.37	0.432328	314.082	3,512.17	3,198.09	(8,287.01)
	8	-	726.49	726.49	8,530.40	7,803.91	0.375937	273.114	3,206.89	2,933.78	(5,353.23)
	9	-	726.49	726.49	8,530.40	7,803.91	0.326902	237.491	2,788.60	2,551.11	(2,802.12)
	10	-	726.49	726.49	8,530.40	7,803.91	0.284262	206.514	2,424.87	2,218.36	(583.76)
	11	-	726.49	726.49	8,530.40	7,803.91	0.247185	179.577	2,108.59	1,929.01	1,345.25
	12	-	726.49	726.49	8,530.40	7,803.91	0.214943	156.154	1,833.55	1,677.40	3,022.65
	13	-	726.49	726.49	8,530.40	7,803.91	0.186907	135.786	1,594.39	1,458.61	4,481.26
	14	-	726.49	726.49	8,530.40	7,803.91	0.162528	118.075	1,386.43	1,268.35	5,749.61
	15	-	726.49	726.49	8,530.40	7,803.91	0.141329	102.674	1,205.59	1,102.92	6,852.53
	16	-	726.49	726.49	8,530.40	7,803.91	0.122894	89.281	1,048.33	959.05	7,811.58
	17	-	726.49	726.49	8,530.40	7,803.91	0.106865	77.636	911.60	833.96	8,645.54
	18	-	726.49	726.49	8,530.40	7,803.91	0.092926	67.510	792.70	725.19	9,370.73
	19	-	726.49	726.49	8,530.40	7,803.91	0.080805	58.704	689.30	630.59	10,001.32
	20	-	726.49	726.49	8,530.40	7,803.91	0.070265	51.047	599.39	548.34	10,549.66
	21	-	726.49	726.49	8,530.40	7,803.91	0.061100	44.389	521.21	476.82	11,026.48
								33,606.88	44,633.34		

BCR (F) : 1.33
NPV @15% : 11026.46   LAKH TAKA
IRR : 20.61%
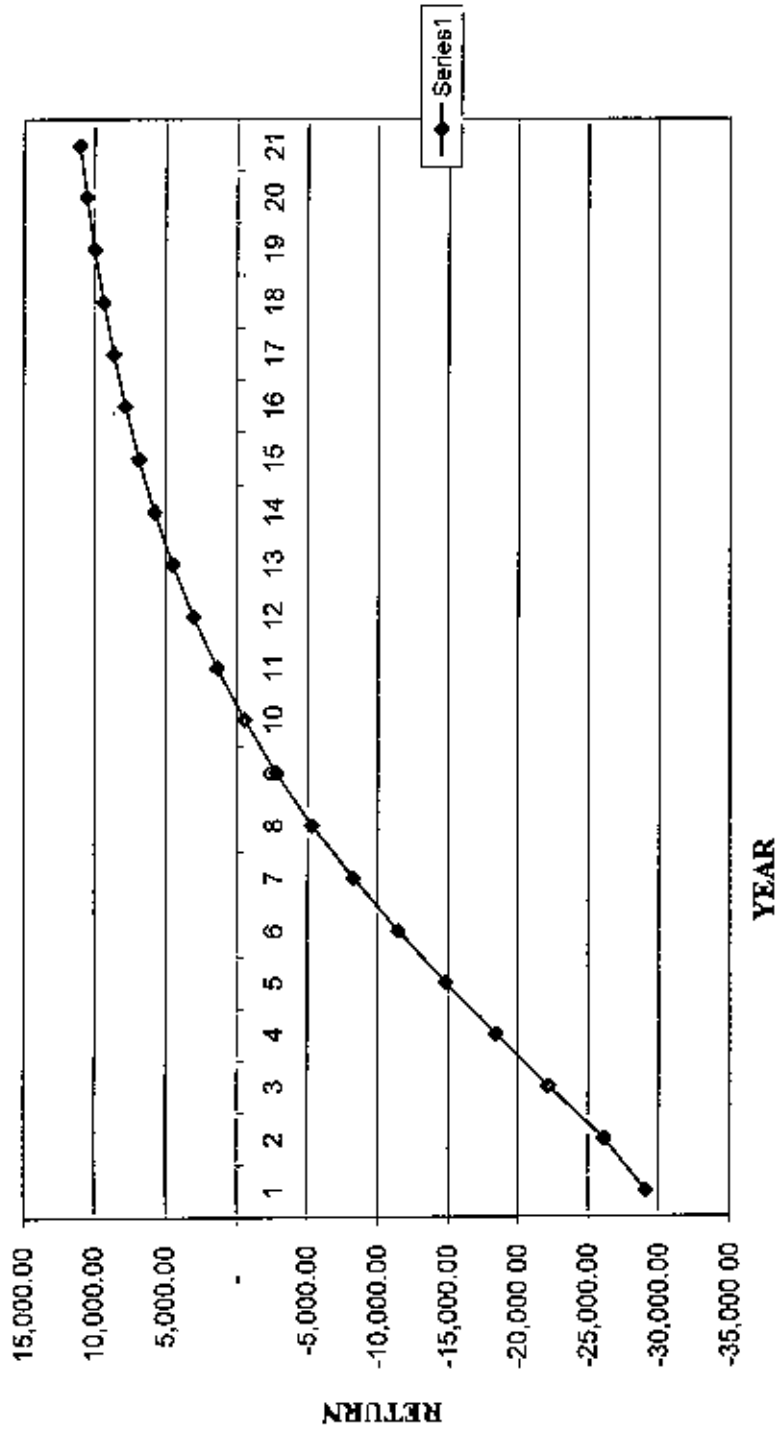
YEAR

Figure J-1: RATE OF RETURN

Table K-1: Annual value of output

APPENDIX K: SITUATION-1.3

Table K-2: Financial analysis of BCR, NPV & IRR

(In Lakh Taka)

YEAR	Investment Cost	Operating Cost(2.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	1	29,059.54	-	29,059.54	-	(29,059.54)	1.000000	29,059.540	-	-29,059.54	-29,059.54
	2	-	726.49	726.49	4,062.09	3,335.60	0.869565	631.730	3,532.25	2,904.52	(26,159.02)
	3	-	726.49	726.49	6,255.62	5,529.13	0.756144	549.331	4,730.15	4,180.82	(21,978.20)
	4	-	726.49	726.49	6,756.08	6,029.59	0.657516	477.679	4,442.23	3,964.55	(18,013.65)
	5	-	726.49	726.49	7,296.57	6,570.08	0.571753	415.373	4,171.84	3,756.46	(14,257.19)
	6	-	726.49	726.49	7,380.30	7,153.81	0.497177	361.194	3,917.90	3,556.71	(10,700.48)
	7	-	726.49	726.49	8,510.71	7,784.22	0.432328	314.082	3,679.42	3,365.34	(7,335.14)
	8		726.49	726.49	8,936.62	8,210.13	0.375937	273.114	3,359.61	3,086.49	(4,248.65)
	9	-	726.49	726.49	8,936.62	8,210.13	0.326902	237.491	2,921.40	2,683.91	(1,564.74)
	10	-	726.49	726.49	8,936.62	8,210.13	0.284262	206.514	2,540.34	2,333.83	769.09
	11	-	726.49	726.49	8,936.62	8,210.13	0.247185	179.577	2,209.00	2,029.42	2,798.51
	12	-	726.49	726.49	8,936.62	8,210.13	0.214943	156.154	1,920.86	1,764.71	4,563.22
	13	-	726.49	726.49	8,936.62	8,210.13	0.186907	135.786	1,670.32	1,534.53	6,097.75
	14	-	726.49	726.49	8,936.62	8,210.13	0.162524	118.075	1,452.45	1,334.38	7,432.13
	15	-	726.49	726.49	8,936.62	8,210.13	0.141329	102.674	1,263.00	1,160.33	8,592.46
	16	-	726.49	726.49	8,936.62	8,210.13	0.122894	89.281	1,098.26	1,008.98	9,601.44
	17	-	726.49	726.49	8,936.62	8,210.13	0.106865	77.636	955.01	877.38	10,478.82
	18	-	726.49	726.49	8,936.62	8,210.13	0.092926	67.510	830.44	762.93	11,241.75
	19	-	726.49	726.49	8,936.62	8,210.13	0.080805	58.704	722.12	663.42	11,905.17
	20	-	726.49	726.49	8,936.62	8,210.13	0.070265	51.047	627.93	576.88	12,482.05
	21	-	726.49	726.49	8,936.62	8,210.13	0.061100	44.389	546.03	501.64	12,983.69
								33,606.83	46,590.56		

BCR (T): 1.39
NPV @15% : 12983.69 LAKH TAKA
IRR : 21.52%

Figure K-1: RATE OF RETURN

APPENDIX L: SITUATION-14

Table L-1: Annual value of output

Table L-2: Financial analysis of BCR , NPV & IRR

(In Lakh Taka)

YEAR	Investment Cost	Operating Cost(2.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	1	29,059.54	-	29,059.54		(29,059.54)	1.000000	29,059.540	-	-29,059.54	-29,059.54
	2	-	726.49	726.49	4,062.09	3,335.60	0.869565	631.730	3,532.25	2,900.52	(26,159.02)
	3	-	726.49	726.49	6,824.32	6,097.83	0.756144	549.331	5,160.17	4,610.84	(21,548.18)
	4	-	726.49	726.49	7,370.26	6,643.77	0.657516	477.679	4,846.06	4,368.39	(17,179.79)
	5	-	726.49	726.49	7,959.89	7,233.40	0.571753	415.373	4,551.09	4,135.72	(13,044.07)
	6	-	726.49	726.49	8,596.68	7,870.19	0.497177	361.194	4,274.07	3,912.88	(9,131.19)
	7	-	726.49	726.49	9,284.40	8,557.91	0.432328	314.082	4,013.91	3,699.82	(5,431.37)
	8	-	726.49	726.49	9,749.02	9,022.53	0.375937	273.114	3,665.02	3,391.90	(2,039.47)
	9	-	726.49	726.49	9,749.02	9,022.53	0.326902	237.491	3,186.97	2,949.48	910.01
	10	-	726.49	726.49	9,749.02	9,022.53	0.284262	206.514	2,771.28	2,564.76	3,474.77
	11	-	726.49	726.49	9,749.02	9,022.53	0.247185	179.577	2,409.81	2,230.23	5,705.00
	12	-	726.49	726.49	9,749.02	9,022.53	0.214943	156.154	2,095.48	1,939.33	7,644.33
	13	-	726.49	726.49	9,749.02	9,022.53	0.186907	135.786	1,822.16	1,686.37	9,330.70
	14	-	726.49	726.49	9,749.02	9,022.53	0.162528	118.075	1,584.49	1,466.41	10,797.11
	15	-	726.49	726.49	9,749.02	9,022.53	0.141329	102.674	1,377.82	1,275.15	12,072.26
	16	-	726.49	726.49	9,749.02	9,022.53	0.122894	89.281	1,198.10	1,108.81	13,181.07
	17	-	726.49	726.49	9,749.02	9,022.53	0.106865	77.636	1,041.83	964.19	14,145.26
	18	-	726.49	726.49	9,749.02	9,022.53	0.092926	67.510	905.94	838.43	14,983.69
	19	-	726.49	726.49	9,749.02	9,022.53	0.080805	58.704	787.77	729.07	15,712.76
	20	-	726.49	726.49	9,749.02	9,022.53	0.070265	51.047	685.01	633.97	16,346.73
	21	-	726.49	726.49	9,749.02	9,022.53	0.061100	44.389	595.67	551.28	16,898.01
								33,606.88	50,504.90		

BCR (F) : 1.50
NPV @15% : 16898.02   LAKH TAKA
IRR : 23.27%

YEAR

Figure L-1: RATE OF RETURN

Table M-1: Annual value of output

YEAR	No. of Outreach					Construction (K'M)							Annual Value of output				Total Result
No.	Power Station	Outlet	No.	Pump	No.	Power Station	No.	Pump	Const.	Total	No.	Power Station	Const.	Total		Pump	(K'M /mth)

Table M-2: Financial analysis of BCR, NPV & IRR

(In Lakh Taka)

YEAR	Investment Cost	Operating Cost(2.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	29,059.54	-	29,059.54	-	(29,059.54)	1.000000	29,059.540	-	-29,059.54	-29,059.54
2	-	726.49	726.49	4,062.09	3,335.60	0.869565	631.730	3,532.25	2,900.52	(26,159.02)
3	-	726.49	726.49	7,108.67	6,382.18	0.756144	549.331	5,375.18	4,825.85	(21,333.17)
4	-	726.49	726.49	7,677.37	6,950.88	0.657516	477.679	5,047.99	4,570.31	(16,762.86)
5	-	726.49	726.49	8,291.54	7,565.05	0.571753	415.373	4,740.71	4,325.34	(12,437.52)
6	-	726.49	726.49	8,954.87	8,228.38	0.497177	361.194	4,452.16	4,090.96	(8,346.56)
7	-	726.49	726.49	9,671.26	8,944.77	0.432328	314.082	4,181.16	3,867.07	(4,479.49)
8			726.49	10,155.24	9,428.75	0.375937	273.114	3,817.73	3,544.62	(934.87)
9	-	726.49	726.49	10,155.24	9,428.75	0.326902	237.491	3,319.77	3,082.28	2,147.41
10	-	726.49	726.49	10,155.24	9,428.75	0.284262	206.514	2,886.75	2,680.24	4,827.65
11	-	726.49	726.49	10,155.24	9,428.75	0.247185	179.577	2,510.22	2,330.65	7,158.30
12	-	726.49	726.49	10,155.24	9,428.75	0.214943	156.154	2,182.80	2,026.64	9,184.94
13	-	726.49	726.49	10,155.24	9,428.75	0.186907	135.785	1,898.09	1,762.30	10,947.24
14	-	726.49	726.49	10,155.24	9,428.75	0.162528	118.075	1,650.51	1,537.44	12,479.68
15	-	726.49	726.49	10,155.24	9,428.75	0.141329	102.674	1,435.23	1,332.56	13,812.24
16	-	726.49	726.49	10,155.24	9,428.75	0.122894	89.281	1,248.02	1,158.74	14,970.98
17	-	726.49	726.49	10,155.24	9,428.75	0.106865	77.636	1,085.24	1,007.60	15,978.58
18	-	726.49	726.49	10,155.24	9,428.75	0.092926	67.510	943.69	876.18	16,854.76
19	-	726.49	726.49	10,155.24	9,428.75	0.080805	58.704	820.59	761.89	17,616.65
20	-	726.49	726.49	10,155.24	9,428.75	0.070265	51.047	713.56	662.51	18,279.16
21	-	726.49	726.49	10,155.24	9,428.75	0.061100	44.389	620.49	576.10	18,855.26
							33,606.88	52,462.14		

BCR (F) :   1.56
NPV @15% : 18855.26   LAKH TAKA
IRR :   24.13%
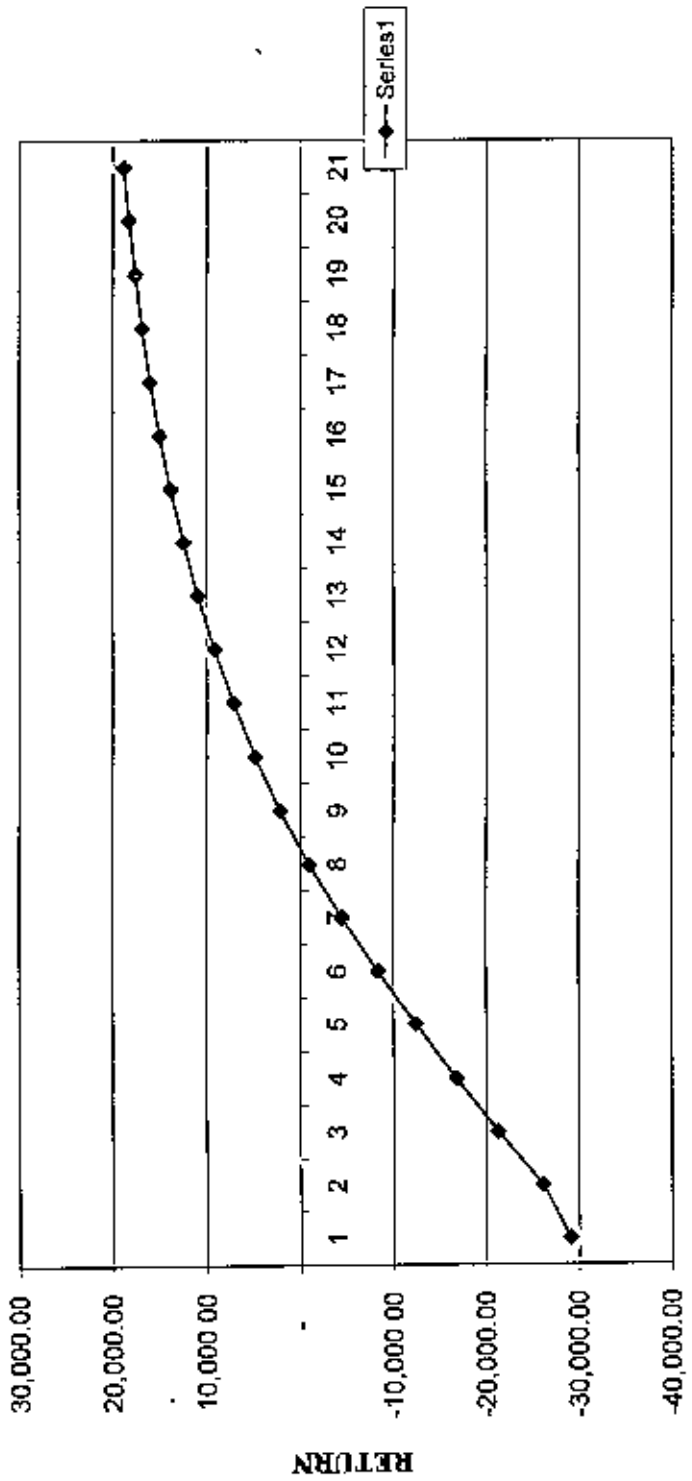
YEAR

Figure M-1: RATE OF RETURN

APPENDIX N: SITUATION-16

Table.N-1: Annual value of output

Table N-2: Financial analysis BCR , NPV & IRR

(In Lakh Taka)

YEAR		Investment Cost	Operating Cost(2.5%)	Total Cost	Total Benefit	Net Benefit	Discount Factor @15%	Discounted Cost	Discounted Benefit	Discounted Net Benefit (Annual)	Discounted Net Benefit (Cumulative)
2008-09	1	29,059 54	-	29,059,54	-	(29,059.54)	1.000000	29,059 540	-	-29,059 54	-29,059 54
	2	-	726 49	726 49	4,062.09	3,335 60	0 869565	631 730	3,532 25	2,900 52	(26,159 02)
	3	-	726 49	726,49	7,393 01	6,666 52	0.756144	549 331	5,590 18	5,040 85	(21,118 17)
	4	-	726 49	726 49	7,984 46	7,257 97	0.657516	477 679	5,249 91	4,772 23	(16,345,94)
	5	-	726 49	726 49	8,623 21	7,896 72	0.571753	415 373	4,930 35	4,514 97	(11,830 97)
	6	-	726 49	726 49	9,313 06	8,586,57	0.497177	361 194	4,630 24	4,269 05	(7,561 92)
	7	-	726 49	726,49	10,058 12	9,331,63	0 432328	314 082	4,348,41	4,034 32	(3,527 60)
	8		726 49	726,49	10,561 45	9,834,96	0 375937	273 114	3,970,44	3,697 33	169 73
	9	-	726 49	726 49	10,561 45	9,834,96	0 326902	237 491	3,452 56	3,215 07	3,384 80
	10	-	726 49	726 49	10,561,45	9,834 96	0 284262	206 514	3,002 22	2,795 71	6,180,51
	11	-	726 49	726 49	10,561,45	9,834 96	0 247185	179 577	2,610 63	2,431 05	8,611 56
	12	-	726.49	726 49	10,561 45	9,834 96	0 214943	156 154	2,270 11	2,113 96	10,725 52
	13	-	726 49	726 49	10,561 45	9,834,96	0 186907	135 786	1,974 01	1,838 22	12,563 74
	14	-	726 49	726 49	10,561.45	9,834 96	0 162528	118 075	1,716 53	1,598 46	14,162 20
	15	-	726 49	726 49	10,561.45	9,834,96	0 141329	102 674	1,492,64	1,389 97	15,552 17
	16	-	726 49	726 49	10,561 45	9,834 96	0 122894	89 281	1,297,94	1,208 66	16,760 83
	17	-	726 49	726 49	10,561 45	9,834,96	0 106865	77,636	1,128 65	1,051 01	17,811 84
	18	-	726 49	726 49	10,561 45	9,834 96	0 092926	67,510	981 43	913 92	18,725 76
	19	-	726 49	726,49	10,561 45	9,834 96	0 080805	58,704	853,42	794 71	19,520 47
	20	-	726 49	726 49	10,561 45	9,834 96	0 070265	51,047	742,10	691,05	20,211 52
	21	-	726 49	726 49	10,561,45	9,834 96	0 061100	44 389	645,30	600 92	20,812,44
								33,606,88	54,419.32		

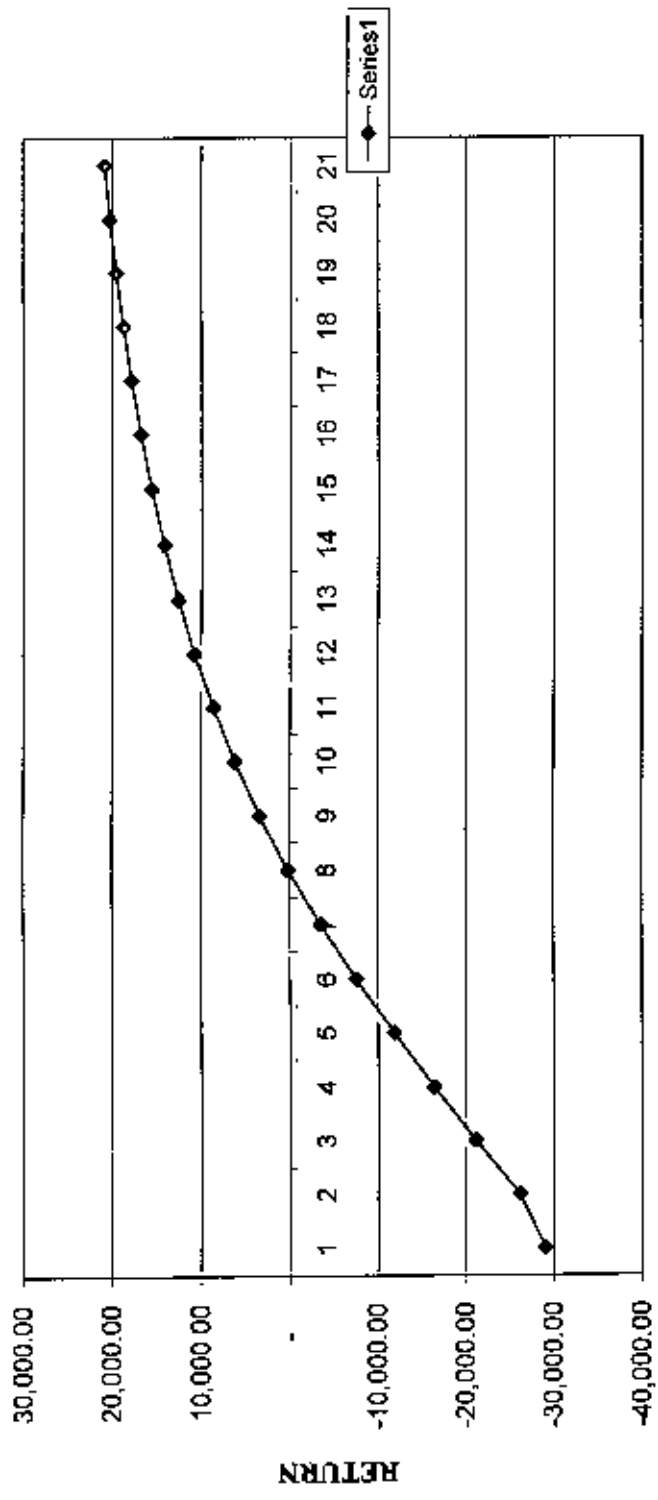|		
BCR (F) :	1.62	
NPV @15% :	20812.44	LAKH TAKA
IRR :	24.96%	

Figure N-1: RATE OF RETURN